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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF AGROSTOLOGY.

[Grass and Forage Plant Investigations.]

THE RED DESERT OF WYOMING

AND

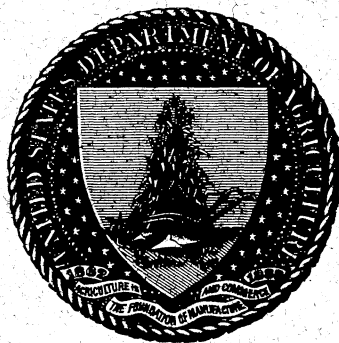
ITS FORAGE RESOURCES.

BY

AVEN NELSON,

Professor of Botany in the University of Wyoming.

PREPARED UNDER THE DIRECTION OF THE AGROSTOLOGIST.



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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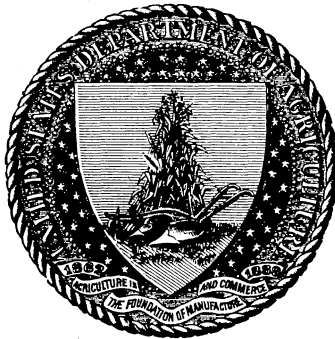
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,

Washington, D. C., June 29, 1898.

SIR: I have the honor to transmit herewith and recommend for publication as Bulletin No. 13 of this Division a report by Prof. Aven Nelson on The Red Desert of Wyoming and its Forage Resources, prepared in accordance with the instructions of the Agrostologist. The Red Desert region of Wyoming is a waterless and nearly treeless area. During the summer season it is practically uninhabitable, and a visitor at this time would doubt very much whether the region could be utilized in any way, especially as a stock range, but as a matter of fact this Red Desert actually affords excellent winter pasturage. Here are fed the herds and flocks of adjacent summer ranges, and many of the stockmen in northwestern Colorado, eastern Utah, and southern Idaho find in this region a desirable place to winter their stock, especially their sheep. So far as I am aware, we have in this report the first presentation of the value of the Red Desert and other similar regions which occur in the interior of all large continents as ranges for stock, and the account given of the various forage plants upon which thousands of cattle and sheep graze during the winter months can not fail to be of interest. Among these plants which afford nutritious food and apparently thrive in the driest climates and in strongly alkaline soil there are doubtless varieties that are well deserving of propagation, and by their cultivation land now totally waste may be rendered valuable.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE RED DESERT OF WYOMING AND ITS FORAGE RESOURCES.

INTRODUCTION.

The region known as the Red Desert lies in southern Wyoming. Our knowledge of the plants of this region has heretofore been very imperfect, due chiefly to the difficulty and hardships involved in conducting investigations during the summer months. As the Union Pacific Railroad traverses the entire region from east to west, information concerning its vegetation has, of course, been accumulating, but previous to the present season (1897) no systematic survey of its resources has ever been attempted.

There is little in view from the car windows to invite closer inspection or more personal contact. From the Platte River to the Green River, a distance of 150 miles, there is not within sight of the railroad any vegetation larger than sage-brush and grease-wood, and through much of the distance these also seem dwarfed and scattering. Bright green hues are extremely rare. With the exception of the fringes on the banks of the few little creeks and the occasional bogs, the vegetation is marked by colors which blend closely with those of the ground, the dull grayish greens and grays varying to silvery white. To this absence of bright coloring in vegetation, is largely due the singularly barren appearance of the whole region, and no doubt its reputed desert-like condition is traceable to the same cause. Portions of the region are deserted during a part of the year, but it is far from being a desert if by that term is meant "bare of vegetation." This is attested by the fact that great herds of cattle and flocks of sheep are profitably wintered there year after year.

The conditions surrounding the Red Desert made it evident that the region was an interesting field for investigation either from an economic or a botanical standpoint. In order to gain an adequate idea of its vegetation, it was deemed necessary to make at least three incursions into the heart of the region for the spring, summer, and autumn floras, respectively. In pursuance of this plan, the first trip was made under the direction and in the interest of the experiment station of the University of Wyoming. The two later expeditions were made under a commission from the Secretary of Agriculture through the chief of the Division of Agrostology.

In this report account is taken of the field observations and material obtained during the three trips into the region. The material secured during the first trip was miscellaneous in its character, all plants then in condition for collection being included. On the later trips only such plants as were of known or possible forage value were collected.

ITINERARY.

In order to gain an adequate idea of the flora of the desert as related to the stock interests of the State one must know something of the summer pasture as well as the winter range. On this account the field work was extended into the hills and mountains of the southern border of the State, both east and west from the desert.

To examine in detail all this vast region in one season is evidently an impossibility, nor is it probable that such a comprehensive survey would prove profitable, for within the desert can be found certain distinctive areas, a knowledge of which will give a fair idea of the whole.

On account of the limited time at command for the first trip (ten days in the latter part of May and early June), observations and collections had to be confined to areas adjacent to the railroad stations. Though the trip was extended as far west as Evanston, most of the time was spent within the Red Desert proper, at Green River, Point of Rocks, Bitter Creek, Red Desert Station, Wamsutter, and Fort Steele.

While working under the commission above referred to, places in the desert were explored more or less thoroughly during July and again during the latter part of August and early September. Creston, Wamsutter, Bitter Creek, Point of Rocks, Rock Springs, and Green River served as bases from which contiguous territory was investigated, and together they gave a representative series of the forage plants on an east and west line. To obtain an equally representative series on a north and south line two expeditions were made. The northern part of the desert was investigated by a journey from Point of Rocks to South Butte, Fifteen Mile Springs, and Black Rock Butte. As at each of these places there are springs, while the intervening country is typical of the plains portion, these collections are fairly representative of the northern portion of the region.

To similarly investigate the southern half of the desert, a journey was made from Rock Springs by way of Cooper's ranch to Rife's ranch on North Vermilion Creek, the location of a former post-office called Vermilion. This is about 55 miles from Rock Springs, and between the two places there is no usable water except at the Cooper ranch, which serves as the "half-way place" in making the journey. Mr. Rife's ranch is located just on the border of the desert in the foothills of Pine Mountain, on either side of which stand the low, wooded, Bishop and Diamond mountains.

While making the ranch headquarters a few days were spent investigating the forage plants of the adjacent hills and mountains, extend-

ing the observations south to the Colorado-Wyoming line. Here was found the region of the ideal summer pasture, an area which those who depend upon the desert for winter forage utilize for summer range.

The return to Rock Springs was made by another route, the midway watering place being at "The Gap," a pass through a range of hills. This journey, both going and returning, was made so leisurely as to afford ample opportunity for collecting and observation. This glimpse of the rich summer range to the southwest of the desert made it desirable that more should be known of the forage which fattens for the autumn markets so much of the stock whose winter range is in the desert. Accordingly, observations and collections, both east and west, were made. For points west, Evanston and Granger were selected, and were visited in late July and again in late August and early September. For points east, some localities in the Medicine Bow Mountains of Albany County and in the Sierra Madre Mountains of Carbon County, were chosen for investigation. Outfitting for this latter work at Laramie, the first three weeks of August were devoted to the investigation, resulting in large and interesting collections.

A knowledge of the forage of the summer range adjacent to the Red Desert is interesting and valuable from the fact that the floras of the two areas are complementary to each other, each rendering the other available by giving range forage throughout the year to the stock of the region. Because of climatic and vegetal conditions one is unsuitable during that part of the year when the other is at its best.

LOCATION AND EXTENT OF THE RED DESERT.

The area originally designated by the name Red Desert is but a small part of what is now considered as within its boundaries (see Pl. I, fig. 1). The name was first applied to a tract, possibly less than 15 by 20 miles in extent, characterized by the peculiar red clay soil of the Wasatch Eocene formation. Near the center of this limited but really *red* desert area we find the side track and section house on the Union Pacific bearing the designation "Red Desert."

The larger Red Desert as now understood includes, however, all that arid section of salt-impregnated soil in southern Wyoming, in which the salt-sages predominate, and which, on account of the absence of suitable stock water, can only be used for winter pasture. The stock owner who speaks of his stock "feeding" (not "grazing") in the Red Desert uses the name of the region in this comprehensive sense.

This region includes, when bounded in this way, a well-marked plant formation or area. It may be said to extend from the Platte bluffs on the east to the Green River bluffs on the west; from the northern limit of Sweetwater County to the hills and mountains separating Colorado and Wyoming on the south. Geographically, then, it is situated between latitudes 41° and $42^{\circ} 20'$ north and longitudes 107° to $109^{\circ} 30'$ west. Excluding from this rectangle the southwest corner, which

is fairly well watered, there still remains a tract approximately 85 by 130 miles in extent, embracing more than 11,000 square miles, an area much larger than the State of Massachusetts. This vast area is included in that part of Sweetwater County east of Green River and certain portions of Carbon County west from the Platte.

TOPOGRAPHY.

The Red Desert is a high, undulating plain or plateau, crossed and intersected at intervals by low ranges of hills (Pl. I, fig. 2). Occasional buttes occur, standing sentinel over the groups of hills that rim in the shallow basins or form the zigzag bluffs of the many dry draws or the infrequent creeks.

Far toward the northern boundary one sees the large, isolated butte known as Steamboat Mountain, and beyond this, on the horizon's rim, Antelope Hills, Green Mountains, and Ferris Mountains. This series, extending from east to west, forms the watershed on the south side of Sweetwater River and the northern boundary of the desert. To the north of the railroad are the Leucite Hills. Black Rock Butte and Orendo Butte are well-known landmarks. Toward the east, as viewed from the heart of the desert, no relief appears, unless, perchance, a little toward the north one sees the tops of the Seminole Mountains. The southern boundary is made by ranges of hills and occasional wooded mountains, the view of which, however, is intercepted by the high bluffs that border the narrow valleys. On the western border, in the Green River bluffs, there is scenery of no mean type. Here buttes, long famed, overlook a valley that has had a reputation for grandeur and picturesqueness for more than half a century.

Crossing the desert from north to south, east of the center, is the height of land—the watershed of the continent. Here are parted the waters of the Platte and the Green, flowing, respectively, toward the Atlantic and Pacific. The railroad intersects this line near Creston, the exact point being marked by a signboard announcing this fact.

From an altitude of 7,038 feet at Creston, the land slopes away gradually toward the east and toward the west, but probably the average altitude for the whole region, if one takes into account the increased altitudes both in the northern and southern portions, is not far from 7,000 feet. The lowest altitudes are found in the narrow, bluff-bordered valley of Bitter Creek, which (Pl. II, fig. 1), with an elevation of 6,700 feet at Bitter Creek Station, drops to 6,077 feet at its junction with Green River near the town of that name.

GEOLOGY.¹

The geology of the Red Desert is so varied that it is almost impossible to give a suitable brief description. Considering that the desert

¹ The author is indebted to Prof. W. C. Knight for this summary of the geological features of the Red Desert.

extends from the Rawlins uplift west to the Green River, and from the Colorado line north to the bluffs south of the Sweetwater River, it can best be described as follows: In the western portion there is an island-like mass of Cretaceous rocks surrounded by Eocene Tertiary beds. The Cretaceous exposure has been caused by an anticlinal fold whose western limit is some distance north of Salt Wells, and which extends in a southern direction nearly to the State line. The exposed core of this fold belongs to the Fort Pierre group, around which are extensive beds of Fox Hills and Laramie formations. On the east flank of this fold are the coal mines at Point of Rocks, Hallville, and Black Buttes; on the west are the celebrated coal mines at Rock Springs. To the west of Rock Springs the Green River Eocene (?) lies conformable upon the Laramie.

The Green River beds are made up of shales that are cut by deep and almost inaccessible canyons. The canyon of the Green River is at some points more than 1,000 feet deep.

From Black Buttes eastward there is a synclinal basin that is covered with Wasatch and Bridger Eocene, beyond which to the east the Laramie outcrops and extends from the State line north to Green Mountain, forming the eastern boundary of the desert.

The Tertiary rocks covering the basins are quite level, and only form bluffs and escarpments occasionally along the railroad. To the north the country is level for from 30 to 40 miles to where it is hemmed in by high and precipitous bluffs. This rough country extends along the entire northern border. In the northwestern portion the country is very broken, and the castle-like buttes rise to a height of 2,000 to 3,000 feet above the level country.

Oregon Butte is a famous old landmark, and is in reality a mountain made by erosion.

South of the railroad the country is also broken, but is in no way comparable with the northern border.

Another interesting feature is the eruptive overflows in the Cretaceous rocks some 12 or 15 miles north and west of Point of Rocks. The main eruptive mass is known as the Leucite Hills, but there are numerous outlying elevations, such as Pilot Butte, Flat Top, and Black Rock Butte.

SOILS.

The soil of the Red Desert differs materially in the different parts of the region. It is, however, little more than the geological formations would indicate. Probably all the soils of the region must be characterized as saline, but the absolute amount of salts present in any particular locality depends to a great extent upon the conformation of the surface. Through long-continued processes of leaching some formations have lost and others have gained in salt content. Flats and basin-like depressions, receiving the drainage from the slopes, have become more and more heavily impregnated. The rainfall is too limited

to carry much of this salt away, so it is found incrusting the banks of the creeks and the margins and beds of the dry or shallow lakes. Some of the abrupt slopes where heavy winter snowdrifts lie are fairly free from injurious salts, and, judging from the appearance of the vegetation, have nearly normal mountain soil. Almost all the soils are poor in humus.

The character of the soil as determined by constituents and water content gives five fairly distinctive formations. These may be designated and characterized under the following divisions:

Plains soils.—Surface more or less undulating, hence fairly well drained and losing slowly some of the soluble salts; soil consisting of clay, gravel, or sand, or these mixed in various proportions. Strictly speaking, it is not a true plain, but undulating or even hilly, with long gentle slopes leading to the basins and ravines. It includes all the land with sufficient slope for drainage.

Alkali soils.—Depressions or basins without drainage and flats adjacent to creek beds; salt constituents increasing; soil, a mixture of fine clay and sand with the salts.

Paludal soils.—Marshy bogs about springs and the margins of some of the few creeks; bogs of all characters from nearly fresh to highly saline or mineralized.

Snowdrift soils.—The draws and abrupt slopes where snow accumulates and lies till late spring or early summer; gravelly or sandy soil, often of a loamy character, due to the considerable amount of decomposing vegetation.

Cedar Bluffs soils.—More or less abrupt slopes of shale, sandstone, or sand; soil inferior, but fairly free from salts; hence a somewhat varied, though stunted, vegetation.

COMPOSITION OF ALKALI IN RED DESERT SOIL.

The analyses¹ of some representative soils from the desert show that they are among the most pronounced of the so-called alkali soils, and that the principal salts are sodium chloride and sodium sulphate, while sodium carbonate, or black alkali, is not wholly absent.

The following analysis of soil for the alkali contents from the desert 21 miles northwest of Rawlins may be taken as fairly representative of the better soils of the Red Desert in general:

Alkali (water-soluble salts), 0.12 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride.....	18.5
Sodium sulphate.....	37.1
Calcium sulphate.....	35.0
Magnesium sulphate.....	9.4
	<hr/> 100.0

¹The author is indebted to Prof. E. E. Slosson, chemist of the Wyoming Experiment Station, for the analyses, and to Professors Buffum and Knight for one each of the samples.

A sample from Bitter Creek flats (second bottom land, on which salt-sages flourish) shows the following composition:

Alkali (water-soluble salts), 0.86 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride.....	74.1
Sodium sulphate	25.9
	<hr/> 100.0

On the first bottom or low banks of Bitter Creek, on which *Atriplex pabularis*, *Agropyron tenerum*, *Chrysothamnus linifolius*, and one or two species of *Juncus* and *Scirpus* flourish, we find a much greater salt content, as the following analysis shows:

Alkali (water-soluble salts), 8.67 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride	6.44
Sodium sulphate	83.12
Calcium sulphate	5.39
Magnesium sulphate	3.35
Iron and aluminum	1.70
	<hr/> 100.00

As indicating the presence and amount of sodium carbonate, the following analysis of a sample from Orendo Butte will be of interest. The ground from which this was taken undoubtedly has its counterpart in many other localities in the desert:

Alkali (water-soluble salts), 7.20 per cent of soil.

Composition of alkali:

	Per cent.
Sodium chloride.....	4.08
Sodium sulphate	50.41
Sodium carbonate	45.51
	<hr/> 100.00

Without giving any more of the analyses in detail, it may be stated that the foregoing do not represent the soils in which the largest amounts of alkali are present and vegetation still existing. In the bed of a dry pond a species of *Scirpus* was growing where the surface soil contained more than 60 per cent of soluble salts.

CLIMATE.

No reliable data are at hand from any locality within the desert either as to temperature or precipitation. On this account only general statements can be made, based upon limited personal observation and such information as could be gathered from the residents of the region.

TEMPERATURE.

The temperature is certainly very variable, rising during the long, clear days of summer to almost tropical heat and falling at night nearly or quite to the freezing point. The dry, rarefied air of these high altitudes permits the free passage of the sun's rays, so that during still days

the plains and hills are subjected to almost blistering heat. Radiation being equally unobstructed, all objects soon cool at night.

The high temperature of the day is not oppressive, for it is the direct rays of the sun rather than the stifling heat of a moisture laden atmosphere. Since the atmosphere itself becomes warm only as its moisture accumulates heat in latent form, high temperatures are not reached except in direct sunlight.

This great inequality between day and night temperatures is quite as pronounced in winter as in summer. Very low temperatures are often reached, -40° F. being probably not unknown. The winter, while in some respects not severe, is long; the summer proper, short. Few, if any, months are wholly exempt from frost, and many a hard freeze occurs during the growing season, which follows close upon the melting of the snows in spring.

PRECIPITATION.

The amount of moisture that the region receives is on the whole quite small. During the summer months very little rainfall occurs. Bright, sunny days are the rule. Light showers occasionally fall, but in a few hours afterwards there is little trace of moisture. At this altitude, under the influence of the usual winds and the unobscured sun, the evaporation is simply enormous.

At long intervals occur rainstorms of greater magnitude, sometimes reaching cloudburst proportions. The area covered by them is often as limited as their force is violent. The downpour along the higher ranges of hills and bluffs becomes flood-like. Torrents rush down the slopes, carrying everything before them, into the usually dry ravines and creek beds that for a few hours overflow with a fluid so turbid that the proverbially muddy waters of the Missouri would seem clear in comparison. From this deep, cream-yellow paste there is deposited upon the low banks of the creeks a layer of silt that is pasty and slippery almost beyond belief. This bakes and cracks into hard, irregular bricks, not drying up like ordinary mud. The showers are of little benefit to the locality; the slopes are so abrupt and the vegetation of such a nature that very little of the moisture is held back long enough to penetrate the soil.

By far the most valuable and available sources of water supply are the snows that may occur at almost any time during the year, unless it be during one or two of the summer months. They occur rarely during the early fall, occasionally during the winter, and more frequently during the spring months. These usually melt so gradually that all their moisture, except such as is lost by evaporation, finds its way into the soil.

Especially helpful to the vegetation of the desert are the snows of late spring. These lie like a wet blanket over everything for a few days at a time, completely saturating the soil and providing an abundance of moisture for the rapidly developing vegetation.

Sometimes, usually in late winter or early spring, but liable to come at any time, there occur snowstorms of great severity—blizzards which last from one to three days. Inasmuch as these are accompanied or followed by high winds, the plains or level stretches are soon blown bare, the snow being piled in great drifts under the brow of some range of hills, in the many draws and ravines, and to the leeward of patches of sage-brush and grease-wood.

WATER SUPPLY.

To say that the water supply is very limited and of poor quality is hardly necessary. The name of the region and the names of its creeks tell the tale without comment. Bitter Creek, with its tributaries, constitutes the drainage system. This creek originates in the height of land in the southeastern portion, takes a westward course, and, after a tortuous journey of probably 75 miles, empties into Green River.

Probably at no time is it quite dry, but in no part of its course, except in flood time, is it so wide that one can not in many places step from bank to bank. Its only tributary from the north is Killpacker Creek, while from the south it receives Little Bitter Creek and South Bitter Creek. The latter is very generally called Salt Wells Creek, but in character of water is very similar to the others, and in size almost equals the main stream.

In the northern part of the desert a few other small creeks originate, but they are all entirely lost in the sandy depressions toward which they flow or in the nearly dry alkali lakes which they feed. The names of these are suggestive, such as Lost Creek, Alkali Creek, Lost Soldier Creek, Separation Creek, and others nearly as significant.

As may be expected, the waters of these creeks are practically saturated solutions of the soluble mineral ingredients found in the soils of the tributary basins. At no time either during flood or drought are their waters suitable for domestic use.

There are, however, within the region a number of springs, or rather groups of springs, but these are often at great distances from each other. The waters of most of them are of a mineral character, iron and sulphur being of most frequent occurrence. These latter, with the few non mineral springs, furnish the available potable waters of the region, at present at least, with one exception noted below.

If the surface waters are bad, the artesian waters are not much better. The Union Pacific Railroad Company has put down wells at several points between Rawlins and Green River, some of which furnish an abundance of water for steam purposes, but so far only one has been found suitable for domestic use. This one, located at Point of Rocks, furnishes an almost unlimited supply of "good" sulphur water. It is the only source of water supply for all stations between Rawlins and Rock Springs, the latter securing its water from Green River by pipe line. To a score of stations and section houses, covering 121 miles of

the road, water is hauled in cars and emptied into cisterns, from which it is drawn as needed. When exposed to the air it loses to some extent its sulphurous odor and taste. In this region the emigrant trail runs parallel to the railroad, and the dusty traveller and the thirsty horses refresh themselves at the oft-recurring and generous cisterns.

EXTENT OF SETTLEMENT.

The population of the desert is small, and from necessity will not for some time at least be greatly increased. Outside of the towns and stations on the Union Pacific Railroad there are not in all this 11,000 square miles more than 200 inhabitants.

Nearly the whole population of the region is found in immediate proximity to the railroad. To this population the railroad and commercial and official interests, together with the coal-mining industry, give employment in large part. However, a number of men who have stock interests of greater or lesser magnitude in the country make their homes in the towns. The remnant of population outside of these is found upon widely separated ranches, which are scattered over the desert where the occasional springs of usable water permit, or, more frequently, along its borders where streams of fresh water come down from the hills, making possible the well irrigated and successful ranch.

At a very few of the springs that are not too distant from the towns there have been established highly successful and profitable gardens and truck farms. The products of these oases find a ready market in Rock Springs and other points upon the railroad.

The increase in the population of the desert will be largely an increase in the size of the towns. While the range interests of the region are capable of considerable expansion, yet those who may engage in the stock industry will, for many reasons, more frequently make their homes in the towns than upon the borders of the desert, remote from the conveniences of civilization.

PLANT FORMATIONS.

The region shows no well-marked plant formations or areas except such as are bounded by soil conditions; that is, the character of the vegetation of one part of the desert as compared with another, depends upon soil constituents and amount of water. Considered from this standpoint, the following grouping may be serviceable in pointing out the characteristic vegetation:

VEGETATION OF THE DIVISIONS OF THE DESERT.

Plains division.—Under this designation may be included nearly three-fourths of the entire desert. The vegetation here is easily distinguished from that of the rest of the desert. The most characteristic vegetation is the common sagebrush (*Artemisia tridentata*), which grows in all the soils which are less strongly impregnated with salt. With

this are other sages, most important among which is Bud-brush (*Artemisia spinescens*). Altogether the most valuable plant, however, is Nuttall's Salt-sage (*Atriplex nuttallii*). This constitutes a large part of the forage of the region. With the foregoing must be mentioned Winter Fat (*Eurotia lanata*), Shad Scale (*Atriplex confertifolia*), the Rabbit-brushes, or Green-sages (*Chrysothamnus*), and a few other shrubby plants (*Tetradymia*, etc.). Besides this shrubby vegetation there are a number of grasses that form a somewhat scattering growth. Most prominent among these are the Wheat-grasses (*Agropyron*) and Indian Millet (*Eriocoma cuspidata*).

Alkali division.—Next in importance are the plants on the strongly alkaline soil, the land immediately bordering the creeks, the low flats adjacent, and the shallow dry lake beds. Here we find sagebrush largely replaced by Grease-wood (*Sarcobatus*), and with this a great admixture of Salt-sages (*Atriplex*) and a few species of rushes and sedges.

Paludal division.—This includes the occasional spring bogs and creek marshes where occurs a dense growth of grasses, sedges, and rushes, including a large number of species.

Snowdrift division.—This comprises the areas of permanent winter snows, that is, the deep "draws" and abrupt slopes where snowdrifts pile upon snowdrifts. Here, besides Sage-brush, are found occasional clumps of Choke-cherry, Service-berry, Mountain-mahogany (*Cercocarpus*), etc., besides a great profusion of herbaceous vegetation, including many valuable grasses and sedges.

Cedar-Bluffs division.—On some of the higher or at least the more abrupt hills and slopes occurs a scattering and stunted growth of juniper, a scraggy shrub or small much-branched tree. Scattered among the junipers are various small shrubs and occasional patches of fine grass.

DISTINCT TYPES OF VEGETATION.

In the preceding outline no attempt has been made to draw attention to any except the more enduring and therefore the vegetation of most economic importance. To understand the flora of the region one must consider two somewhat distinct types:

Persistent vegetation.—Those plants which are more or less in evidence throughout the year.

Transient vegetation.—All those plants which spring up each year from seed or from such underground parts as bulbs, tubers, or root-stocks. Most of the plants of this character spring up quickly, blossom, bear fruit, wither, and disappear for the rest of the year. These plants far outnumber the persistent type. This transient vegetation follows close upon the retreating snows. The warm sun of the many bright days of spring and the grateful moisture coax out a few forms in April, while in May the wild mustards, beans, chickweeds, composites

of many kinds, Pentstemons and Eriogonums troop forth in great profusion on all the slopes. These, however, soon succumb to the unobscured summer sun. By the end of June most of them are dead and blown away, only a few seed stalks lingering to tell the tale of what has been.

FORAGE.

The Red Desert is distinctively a stock region. Outside of the few favored spots kept fresh by springs, there are no farms or gardens.

From the 1st of June till the 1st of November the region is practically devoid of stock of all kinds. With the coming of the snows the herds and flocks are worked back into the desert from the summer pastures in the hills and mountains. Through the winter and spring months thousands of head feed upon this rough forage, the snowdrifts furnishing the water for all. The sheep herder in his wagon, also dependent upon the snows, guides his flock from district to district as new pasturage is needed. By the time the stock is taken to the summer range the desert is barren indeed. Grasses, sage-brush, salt-sage, white-sage, rabbit-brush, and even cedar boughs have been grazed so close that every edible sprig is gone.

AMOUNT OF FORAGE.

The number of head of stock that the vegetation of a district will support gives some idea of the amount of forage produced. While giving no facts in pounds or tons, yet relative estimates may be secured. Since the desert neither occupies the whole of any one county nor is confined altogether to a single county, no statistics separate from those of the several counties which are in part within the desert can be given. The desert includes a large part Sweetwater County, a county somewhat smaller than the whole of the desert. The following official figures for this county, showing the number of head of stock supported, will, therefore, be a fair estimate for the desert as a whole. The figures are given for three years, in order to show what may be expected from its forage one year with another.

Stock supported in Sweetwater County.

Year.	Horses.	Mules.	Cattle.	Sheep.
1895	1,918	92	2,802	158,050
1896	2,030	246	2,227	170,290
1897	1,640	72	1,882	166,843

Besides this stock, there are trailed through this county each year from 150,000 to 200,000 sheep. These are driven along slowly, the passage of some of the flocks through the county occupying weeks.

During the winter months the adjoining counties, especially Carbon County, and the adjoining States—Colorado, Utah, and Idaho—greatly

swell the total of the stock that feeds within the desert. Flocks of sheep are brought in from all directions, and while of these there has not up to the present been any official record, yet enough is known to indicate that the estimates of the most conservative sheepmen are too low rather than too high. These place the total number of sheep in the desert, during some five months of the year, at 300,000 to 500,000. Some estimates for the winter of 1896-97 were as high as 800,000.

Of the surrounding counties, Carbon County sustains the closest relation to the Red Desert. A portion of the county is included in it, and its large flocks of sheep either feed in the desert proper or on vegetation similar to that of the desert during the winter season. The following official returns show what this vegetation will support.

Stock supported in Carbon County.

Year.	Horses.	Cattle.	Sheep.
1895.....	6,248	22,750	288,115
1896.....	6,511	20,991	354,804
1897.....	6,565	18,992	366,521

The figures from the two adjoining counties, Fremont and Uinta, will give further evidence on the question, for flocks from these also feed at times within the desert. To make clearer the relation of the Red Desert to the stock interests the returns from these counties are given.

Stock supported in Fremont and Uinta counties.

FREMONT COUNTY.

Year.	Horses.	Cattle.	Sheep.
1895.....	9,700	27,279	93,300
1896.....	9,858	31,957	114,164
1897.....	5,269	9,770	137,765

UINTA COUNTY.

Year.	Horses.	Cattle.	Sheep.
1895.....	5,521	19,313	157,435
1896.....	4,964	18,923	202,326
1897.....	4,803	17,577	212,829

It should be noted that the large loss in cattle and horses for Fremont County in 1897 is due to the fact that the recent establishment of Bighorn County has transferred to it much stock that prior to 1897 was assessed in Fremont.

The figures given for Carbon, Fremont, and Uinta counties are the actual assessments, and do not cover a considerable number that probably escape enumeration each year, nor those flocks temporarily in these counties as "trail" sheep.

QUALITY OF FORAGE.

The quality of forage, as judged by results, is of the best. Horses, cattle, and sheep do well. If the winters are not too severely cold nor the snow too deep, all kinds of stock not only subsist upon these plants but actually remain in good flesh throughout the winter. Of the grasses that cure upon the ground the Wheat-grasses are the most abundant, and these have long been known to possess high nutritive value. It is, however, the shrubby vegetation that furnishes the largest amount of valuable feed. Such plants are much more succulent than appearances would indicate. Growing on strongly saline or alkaline soils, the Salt-sages and many other plants take up these salts in such quantity that one readily detects them on tasting even a small fragment of a leaf.

Stock feeding upon such plants secures the necessary amount of salt from the food, so that the salting of stock that must be resorted to during the months when the animals are feeding upon the mountain grasses is wholly unnecessary.

MEANS FOR IMPROVEMENT OF THE FORAGE.

How to improve the quality and increase the quantity of available forage in the Red Desert is a most difficult problem. The soil conditions and water supply are such that not much may be hoped for through the expenditure of ordinary effort and means for the desert as a whole. Nor will any sudden or spasmodic effort suffice. Only forces and plans operating for a number of years can be expected to give noticeably great results.

It is very evident, however, that the forces now at work are tending toward improvement. According to the most reliable sheep men the same areas that twenty years ago would only support one sheep will now better support from three to five. This they attribute to gain in the strength of the soil due to the accumulating manure. It seems probable that a more potent factor is found in the following: The vegetation chiefly depended upon for forage is composed of the large number of small shrubs of many kinds previously mentioned. The cutting down to the ground of such vegetation enormously increases the number of annual shoots. From winter to winter this shrubby vegetation has been browsed down closer and closer to the woody bases of the plants, until now the tender annual shoots are produced in much greater abundance. The effectiveness of this browsing is, of course, dependent upon the region being used as a winter pasture only, giving time for growth and recovery each summer.

Something can certainly be done in a small but effective way in the vicinity of those ranches that are now found within the region, or such as may yet be located. Salt-sages or other alkali-enduring vegetation, if the ground be seeded to them, can be made to yield much more

heavily than at present. For this purpose either native or valuable introduced forms (discussed elsewhere in this report) may be used.

The native grasses also are worthy of trial. The writer has seen wonderful results from seeding the ground to some of these, especially the wheat-grasses, and this, too, where the water used for irrigation was far from the best and the ground strong with alkali. Furthermore, the increase in the water supply is not quite hopeless. The region contains many natural basins in which, by the expenditure of a little labor in the construction of dams, much of the water from the accumulated winter snowdrifts might be saved for use later in the season.

On the outskirts of the desert, the problem is much the same as in the greater arid west. Those measures which may be successfully introduced in other localities will be equally successful here.

CHARACTERISTIC DESERT PLANTS.

A question needing full investigation is the relation of plants to alkali or other salts in the soil. Practically all that we know is that some species have adapted themselves to endure or even thrive in soil containing greater or less amounts of various salts. Different species even in the same genus behave very differently in this respect; for example, *Chenopodium album* L. seeks a soil free from salts, while for *C. glaucum* L. there can hardly be too much. If alkali affects a plant injuriously it seems to do so throughout its entire development. It has been shown that alkali retards germination or entirely prevents it in most seeds in direct proportion to the amount of the salt present.¹ Some families of plants have adapted themselves to saline soil more than others. Easily first in this respect is the goose-foot family (*Chenopodiaceæ*). To this belong a large number of distinctively alkali plants, such as the Salt-sages, White Sage, Grease-wood, Russian Thistle, and Australian Saltbush.

In regard to the question of largest representation by species of the families of plants found in the desert, the writer found on examining the collections that the family represented by the largest number of species is not necessarily the most characteristic of the region. The obvious vegetation, that which gives character to the landscape, can be included in a half dozen genera, *Artemisia*, *Tetradymia*, *Chrysothamnus*, *Atriplex*, *Sarcobatus*, and *Agropyron*. Remove all the plants belonging to the three families, *Compositæ*, *Chenopodiaceæ*, and *Gramineæ*, and the region would look like a true desert. Many other families are better represented in number of species, but the individuals are either small or scattering, and bear the same relation to the great mass of vegetation that the occasional weed in a well-tilled field bears to the main crop.

The plants of the following list are worthy of special note. It is

¹ Bull. 29, Wyoming Experiment Station.

intended to include only those that are of first importance either because of the large amount of forage produced or because of their great nutritive value and those that give promise of good results under cultivation. They are here arranged rather in the order of importance for the two regions: (1) Vegetation of the desert, or winter, range (see Pl. I); and (2) vegetation of the hill country, or summer, range (see Pl. II, fig. 2).

VEGETATION OF THE DESERT, OR WINTER, RANGE.

- (1) **The Salt-Sages.**—The salt-sages rank first in the amount of forage produced, and, judging by the number of cattle supported on the winter pastures and the reported fine condition of the stock, these plants possess high nutritive value.

NUTTALL'S SALT-SAGE (*Atriplex nuttallii* S. Wats.).—Of the several species, this stands first in the matter of distribution. It is found nearly everywhere except on the most pronouncedly alkali ground. It belongs not only to this desert and this State but is the most generally distributed salt-sage of the entire arid west. It is the sheepman's most highly-prized winter forage, and certainly here furnishes one-half of the whole supply. Sheep thrive upon it both when it is green and also in the winter after it has cured upon the ground. It is a perennial with a woody base, calculated to endure severe pasturing and much trampling. It is each year eaten down to the ground, leaving only the woody base. It produces seed in abundance, which is greedily eaten, and this probably accounts for its high nutritive value. It seems unsuited for cultivation, except where a perennial pasture is desired, on account of its woody character and slow growth, but where well established it is a source of much feed for all kinds of stock and should not be carelessly destroyed.

NELSON'S SALT-SAGE (*Atriplex pabularis* A. Nels.).—This new species seems to be a form of great promise as a forage plant. Like the preceding, it is a perennial, but the woody base is almost wholly underground. The herbaceous stems are produced in much greater abundance, forming often a close, continuous, erect growth. So far as known it is not widely distributed, being confined to strongly saline areas, such as the flats adjacent to Bitter Creek and its tributaries and the dry beds of alkali basins. It fruits freely, makes a considerable annual growth, and is certainly worthy of trial with a view to forming a permanent pasture on otherwise valueless alkali ground. Its habit of growth would also make it possible to harvest it by the methods applicable to the grasses. Sheepmen unite in pronouncing it prime forage.

TUMBLING SALT-SAGE (*Atriplex volutans* A. Nels., Pl. III, fig. 2).—This heretofore overlooked annual may prove a more valuable plant for certain alkali soils than any of the foreign species that have been so highly recommended. It is a plant of rank growth, and

when not crowded, forms in one season a compact subspherical mass 3 feet or more in diameter. If left to mature on the ground the slender tap-root breaks in the autumn and the plant becomes a tumble-weed. After that time it has probably little nutritive value. If it is ever utilized as a forage plant it must be harvested shortly before maturity. If closely grown this would not be difficult with ordinary machinery. It produces a great abundance of seed that could be thrashed out with very little trouble.

SPINY SALT-SAGE (*Atriplex confertifolia* S. Wats.).—To see this spiny shrub one would hardly think of it as a valuable form of forage, yet sheepmen look upon it as such. They say there is no fault to be found with it except that "there is not enough of it." It is popularly known as Shad scale. It belongs peculiarly to the desert region, where it is eagerly sought in late spring for its tender shoots and leaves. The large quantities of leaves and fruits produced during the summer months are mostly dropped before autumn, but are collected by the winds into little piles under the shrub or in the little hollows of the plain. These the sheep eagerly seek, so that where a band of sheep has fed it is difficult to find either leaves or fruit.

(2) **The Sage-Brushes** (*Artemisia*).—The amount of sage-brush consumed in the desert is simply amazing. Sheepmen and herders say that for sheep a straight sage-brush diet at certain times seems to "meet a long felt want." Whole bands will leave all other forage and browse sage brush for a day or two at a time, after which they will not touch it again for some days, or even weeks. This is especially true of the common sage-brush (*Artemisia tridentata* Nutt.), while some of the other species are so much sought after at all times as to need special mention.

BUD-BRUSH, BUD-SAGE (*Artemisia spinescens* Eaton).—This is the sheepman's "bud-brush." It grows to the height of only a few inches from strong, woody, underground parts. It puts forth numerous leafy stems, profusely covered with clusters of yellowish flowers. The large, bud-like clusters of flowers have suggested the common name. It develops early, being at its best by the end of May. It is said that sheep run hastily from clump to clump in search of this succulent morsel.

SILVERY-SAGE (*Artemisia cana* Pursh).—This in quality probably does not differ materially from the common sagebrush, but, in proportion to area occupied, it produces much more forage. It is found chiefly in the alluvial soil on the banks of streams. Its forage value is due to the production each year of a very large number of long, slender, tender shoots, which are eaten at intervals, as before stated.

(3) **Wheat-Grasses** (*Agropyron*).—For quality these grasses would take first place in the desert forage, but the amount is quite limited.

They cure readily on the ground, and remain more nearly intact throughout the winter months than any of the other grasses of the region. The species of most importance are given as follows:

SLENDER WHEAT-GRASS (*Agropyron tenerum* Vasey).—This wheat-grass is very generally distributed throughout the area. It is found in all parts of the desert, as well as in the better soils of the summer range. It grows in dry, poor soil, but thrives better

in good soil, and responds readily to cultural advantages. A moderate amount of water in irrigation produces best results on this grass. It will hardly stand flooding at all. For pasture purposes there are grasses that will endure more hard treatment than this, but as a meadow grass it must be given first place. It often forms a close, uniform growth that yields as much per acre as an average field of timothy. Considering its high nutritive value, no more profitable grass can be found than this for the desert region, especially on saline soil and where the quantity of available water is limited. While not seeding very freely, the requisite amount for sowing can easily be obtained after the first crop has been harvested. It is easily thrashed out in



FIG. 1.—Western Wheat-grass (*Agropyron spicatum*): a, empty glumes; b, florets.

a machine, or may be flailed out if no better method is at hand. Seed of this grass is now on the market.

COLORADO BLUE-STEM, WESTERN WHEAT-GRASS (*Agropyron spicatum* S. & S., fig. 1).—This grass is capable of enduring drought to a remarkable degree. Naturally, however, it makes a very sparse growth. Distributed rather generally throughout the region, it is found occupying the driest banks and bench lands. It is capable of rank and dense growth under favorable conditions, as shown in

irrigated meadows, where it occurs as the principal grass. Best results will be secured on second bottom lands with moderate water. Flooding should be avoided.

- (4) **Indian Millet** (*Eriocoma cuspidata* Nutt., fig. 2).—The value of this grass has been greatly underrated. It is not only widely distributed, but manages to make a fair growth in desert places, where other grasses are almost wholly absent. It develops early and keeps in fair condition throughout the season. Under favorable conditions it grows to a good size, but even dwarfs specimens fruit freely. All kinds of stock relish it, but horses are particularly fond of the seeds, and will go from bunch to bunch cropping out the heads. On sterile and stony ground it may prove more profitable than any other that could be sown.

- (5) **Giant Rye-Grass** (*Elymus condensatus* Presl).—This is worthy of note because of its conspicuousness rather than its great forage value. To the casual observer this is the grass that would characterize certain localities. It would be thought of as a part of the general relief of the region. The dense bunches, sometimes 5 to 7 feet in diameter and 6 feet high, stand out very prominently on otherwise naked slopes. It is found



FIG. 2.—Indian Millet (*Eriocoma cuspidata*): a, spikelet; b, floret.

all the way from creek banks to the deep "draws" and slopes where snowdrifts accumulate. As forage it is eaten to some extent while young, but becomes unpalatable and harsh as it matures and cures on the ground. It is considered valuable as fodder if cut and cured before it matures. In this condition it is fed to advantage to cattle and horses through the winter months. Possibly if sown thickly and harvested early it might be profitable on account of the quantity produced.

- (6) **Desert Juniper** (*Juniperus knightii* A. Nels.).—To list a tree of any character as a noteworthy forage plant is at least a little unusual. This scrubby, shrub-like juniper, or, as it is usually called, "bluff cedar," has, however, saved many a flock of sheep from extinction. During some of the terrible blizzard-like snowstorms that occasionally occur and last for two or three days the only available forage consists of the branches and tops of this Juniper. The experienced herder keeps working the sheep about, so as to have them on top of the snowdrifts instead of under them. Gradually a trampled-down yard is formed, which, if it be among the cedars, will enable him to hold his flock for some days safely. "Cedar boughs" are not refused under such circumstances, and if not very nutritious, they at least fill the stomachs of the hungry animals.

VEGETATION OF THE HILL COUNTRY, OR SUMMER, RANGE.

A complete discussion of the forage of the vast area which constitutes the summer range of the flocks and herds that winter in the desert is not called for in this report, and would necessitate a more critical investigation in the field of the plant formations that characterize the different areas than they have yet received. Enough is known, however, to enable one to state the character of the forage with a degree of certainty.

It may be said then, first of all, that the summer forage is distinctively herbaceous, strikingly in contrast with the more or less shrubby vegetation of the desert; that it consists primarily of grasses, sedges, and rushes, in contrast with the woody plants of the winter range.

The summer range consists of the mountainous and hilly areas on the outskirts of the desert. It does not include the impenetrable and rugged fastnesses of the higher ranges, such as the Medicine Bow, the Wind River, and the Uinta, but mountains of medium elevation, with rounded slopes, only partially wooded, and well watered with springs and creeks. The timber upon such is open, or, if dense, is interspersed with parks or meadows of most luxuriant growth. Here is a grove of quaking aspen, there some scattering pines, and yonder a spruce-covered summit. In the narrow valleys springs and snow-fed streamlets are found on whose banks occasional clumps of willow or alder occur. In these regions grasses flourish as they never do on the plains. The better soil and the frequent summer showers furnish the conditions for luxuriant growth. Of grasses there are many genera, of which the following are the more valuable:

The Spear-grasses (*Poa*) are easily first as to number and value. After these come a number of groups, all of great value, or at least containing one or more valuable species. Among these are the Brome-grasses (*Bromus*), Wheat-grasses (*Agropyron*), Rye-grasses (*Elymus*), Dropseed grasses (*Sporobolus*), Timothy (*Phleum*), Manna, or Reed,

Meadow-grasses (*Panicularia*), Blue-joints (*Calamagrostis*), Hair-grasses (*Deschampsia*), and Bent grasses (*Agrostis*).

- (1) **The Spear-Grasses** (*Poa* species).—The Spear-grasses, of which there are many valuable species, are most abundant in the hills and mountains and along water courses, but they are not absent even in the desert. In looking over the large list of species secured and the field notes upon them, I find myself unable to fix upon any one as preeminently the most promising or valuable. Some have a wide and general distribution, but are of scattering growth. Others, more local, grow luxuriantly, and for their particular localities stand first. All must be reckoned as pasture grasses of first importance. Some are meadow grasses of importance, especially in native meadows, but for cultivation for hay greater returns can probably be secured from other kinds of grasses. Among those of very general distribution may be mentioned Bunch-grass (*Poa buckleyana*), Alkali Blue-grass (*P. juncifolia*), Smooth Bunch-grass (*P. laevigata* Scribn.), Wood-Meadow grass (*P. nemoralis* L.), Kentucky Blue-grass (*P. pratensis* L.). The last mentioned is undoubtedly native in a large part of the Northwest. In many native meadows and pastures, along water courses, and in the foothills it forms an important part of the sod, and occasionally makes quite a rank growth. Among the more local but very valuable Spear-grasses are Western Blue-grass (*Poa arida* Vasey), Fowl Meadow-grass (*P. flava* L.), Shiny Bunch-grass (*P. lucida* Vasey), Sheldon's Blue-grass (*P. sheldoni* Vasey), Mountain Meadow-grass (*P. reflexa* Vasey & Scribn.), and Wyoming Blue-grass (*P. wheeleri* Vasey). Of these last *P. sheldoni* appeared the most promising, as seen in the field. It is one of the most important grasses of this range, forming a large percentage of the forage on the park meadows among the hills. It is freely eaten by stock and seems to hold its own under the severest pasturing.

- (2) **The Brome-Grasses** (*Bromus*).—The several species of this genus are hardly thought of as pasture grasses on account of their rank growth. Some of the mountain species, however, are valuable as summer forage, while they are also plants of great promise for meadows. Some of the species are well known and have been successfully introduced into many localities. It seems possible, however, that the best are yet to be introduced. Of the eight species collected in the area under consideration, a form common in the Sierra Madre Mountains and their westward extension on the Colorado-Wyoming line seemed by far the most promising:

LARGE MOUNTAIN BROME GRASS (*Bromus multiflorus* Scribn.).—

This is a most striking grass, one that attracts attention at once in a region where fine grasses are the rule. This is the grass that characterizes the locality. To the general observer this would be recalled as the grass not only peculiar to but distinctive of the region. The miners think of it as the feed that their horses sub-

sist upon. It grows upon the hillsides among the fallen timber. It is hardly abundant enough in any locality to form a continuous meadow, but if cut would, on account of its size, supply a fair crop of hay. Horses eat it with avidity and seem to do well upon it. They prefer it to the other abundant grasses of the locality. It was collected at altitudes between 9,000 and 10,000 feet in the parks and open woods, localities in which vegetation hardly starts before June, for almost until that time snow covers all. In consequence of its habitat it matures late, but if introduced into lower altitudes it would undoubtedly prove as early as other grasses of its kind. It grows to a height of 3 to 4 feet, produces an abundance of leaves, and if it would thrive under cultivation as well as in its native habitat it would give an enormous yield.

- (3) **Dropseed** (*Sporobolus depauperatus* Scribn.).—This grass grows along streams, in the foothills, and open parks in the mountains, and even in some of the draws in the desert. It forms a close dense sod, especially where it is freely pastured. On many bottom lands it is the prevailing grass. All kinds of stock seek it out, so that it is difficult to find mature specimens except on inclosed grounds. It seems that it might be introduced with profit into most pastures not only in the mountain regions but generally elsewhere as well. It might also prove valuable as a lawn grass in places where water for irrigation is limited or in lawns that have to endure much trampling. It is possibly a little harsh for this purpose, but frequent cutting would thicken up the sod and reduce the harshness to a minimum.
- (4) **Reed Meadow-Grass** (*Panicularia americana* MacM.).—Among the several manna-grasses this seems by far the most valuable for this region. It is probable that its value as a meadow-grass is not appreciated. For exceedingly wet ground it must prove especially desirable. Here is a grass that will stand flooding. It is adapted to land that is submerged during the growing season, and only needs it to be dry in time for harvesting. It is quite abundant in some localities, and if it were introduced to take the place of the sedges and rushes that so abound in wet or flooded meadows there would be a distinct gain in both quantity and quality of the hay. On Mr. Jacob Johnson's ranch, where it was particularly observed, it occupies many acres. It was being mown at the time, and was accounted one of the most valuable hay grasses. Horses relish it greatly. They were seen wading in mud and water to their knees to secure this when other excellent grasses were superabundant.
- (5) **Redtop** (*Agrostis alba* L.).—Presumably introduced and undoubtedly sown in some meadows, but so widely distributed and in such out-of-the-way places as to indicate that it is also indigenous in the State. It thrives in low, wet ground, and will stand flooding much better than most of the other valuable grasses. It forms a large percentage of the meadow-grasses on the Bear River bottoms. To

substitute it for the sedges and rushes in the meadows of the Laramie river would be the part of wisdom. With this and the tall Reed Meadow-grass the wettest ground could be utilized.

- (6) **The Sedges** (*Carex*).—Of this genus the region affords a very large number of species. They are of varying abundance and value, but it is hard to select, even after observation in the field, the most profitable. Many of them are cut for hay and certainly have nutritive value, but they are hardly to be compared to the better grasses. In many fields, however, they have almost replaced the grasses owing to over-irrigation. The senseless manner in which the water is applied to some of the grass lands must be attributed either to ignorance or indifference. Early in the spring, while the ground is still wet and cold, the lands are submerged and kept in that condition through the season, and are only drained in order that the mowing machines may be taken into the fields. A few seasons of this kind of treatment gives the land over to sedges and rushes and makes it reclaimable with the greatest difficulty. For lands that are naturally wet some species of *Carex* may be found better adapted than the true grasses, at least in certain kinds of soil. Among those that are peculiarly adapted for hay purposes may be named *Carex athrostachya* Olney, *C. festiva stricta* Bailey, *C. lanuginosa* Michx., *C. marcida* Boott, *C. nebraskensis* Dewey, *C. trichocarpa aristata* Bailey, and *C. utriculata minor* Boott. The dense growth of leaves in *C. lanuginosa* and *C. trichocarpa aristata* makes them particularly desirable for hay. The latter yields enormously in some of the fields on the Laramie bottoms. For a pasture sedge there is nothing to compare with *Carex media deflexa* Bailey. It belongs in the mountains, in the open parks, and on the ridges at 9,000 feet and upward. In such places it forms close mats several feet across, and these in places almost touching each other. It grows to only a few inches in height, but produces an abundance of leaves and fruited stems that are much sought after by stock of all kinds. Where it is accessible to stock it is hard to find matured, or fruited, specimens. There are forage plants of more or less value among the rushes, the legumes, and in a few other groups, but these will be noticed in their order in the systematic list.

LIST OF THE FORAGE PLANTS OF THE SUMMER RANGE.

The following grasses and forage plants were collected on the summer range (the hill country bordering the desert) during the season of 1897:

GRASSES.

Panicum virgatum L. (SWITCH-GRASS, fig. 3).—A grass with rather rigid, wand-like, few-leaved stems, 20 to 30 inches high, the fruiting pedicels slender, spreading, the spikes of few but large seeds. Probably rare in the State, as it has been secured only near the Nebraska border. Pine Bluffs, July 6 (3626).

Phalaris arundinacea L. (REED CANARY-GRASS).—A tall, handsome grass, 3 to 5 feet high, with ample, green leaves and long, close panicles. It occurs in wet ground along ditches and creek banks, in shallow bogs and ponds; nowhere observed in abundance, and therefore in its native state of little economic importance. Johnson's Ranch, Big Laramie, August 7 (3910); Grand Encampment Creek, August 13 (3987).

Savastana odorata Scribn. (SENECA-GRASS, fig. 4).—A small grass, 6 to 12 inches high, with large heads; whole plant emits a delightful fragrance. It occurs in cold, swampy ground from middle to high altitudes, sometimes in such quantity as to constitute a perceptible part of the forage. Willow Creek, May 22 (2908).



FIG. 3.—Switch-grass (*Panicum virgatum*): a, spikelets; b, staminate floret; c, floret; d, anterior view of same.

and that if cut after the "seeds" have dropped it forms a good quality of hay. It is very abundant on the plains and in the dry foothills of the eastern part of the State. Pine Bluffs, July 5 (3603).

Stipa nelsoni Scribn. (NELSON'S NEEDLE-GRASS).—This grass belongs to the summer range especially, but it was also secured within the Red Desert. In the wooded, mountain areas it attains to greater luxuriance and is of more frequent occurrence. Woods Creek, August 9 (3963); Battle Lake, August 17 (4059 and 4060).

Aristida fasciculata Torr. (PURPLE BEARD-GRASS).—A closely tufted grass, with slender, very numerous stems, short, slender leaves, the heads with long, divergent awns. Not of frequent occurrence in the State, but in one locality very abundant, where it occupied the dry foothills, especially the loose, broken ground. Pine Bluffs, July 6 (3617).

Stipa columbiana Macoun (COLUMBIAN NEEDLE-GRASS).—A bunch grass with numerous long leaves, the upper part of the stems naked and bearing a long panicle with awns of moderate length, 2 to 3 feet high. It is a rare grass and was sparingly found in scattering bunches in the open woods on the Medicine Bow River, August 20 (4074).

Stipa comata Trin. & Rupr. (NEEDLE-GRASS).—One can scarcely think of this tufted grass, with its long, twisted awns and barbed seeds, as anything but a pest, but stockmen assert that it is valuable for pasture before it heads,

Stipa minor (Vasey) Scribn. (PURPLE-TOP NEEDLE-GRASS).—A bunch grass with numerous slender root leaves, slender, somewhat wiry stems terminated by long heads with divaricate and variously twisted or bent awns of moderate length. The root system, with the dead leaves and stems of the previous year, forms a firm, harsh mat, from which the new stems and leaves arise, 15 to 25 inches high. It seems to belong to the mountain slopes in the region of permanent winter snows, especially among the fallen timber on partially open hillsides. It is not known whether the awns are such as to lessen its forage value.

"G." Summer ranch, July 23 (3828); Battle Lake, August 16 (4026).

Stipa tweedyi Scribn. (TWEEDY'S STIPA).—A bunch grass of spreading habit with long, geniculate, bent awns; stems 20 to 30 inches long. In general appearance it much resembles *S. comata*, and its forage value may well be compared with that. Sheep Mountain, July 3 (3297).

Stipa viridula Trin. (FEATHER BUNCH-GRASS).—A tall, coarse bunch-grass, with a long, close panicle, awns bent, of moderate length, seeds falling early. It occurs in the eastern part of the State on the dry, open plains, but never in any great abundance. Pine Bluffs, July 6 (3613).

Oryzopsis micrantha Thurb. (SMALL-FLOWERED MOUNTAIN RICE).—A rather handsome, slender, spreading grass with long, slender root leaves, panicles loose and spreading, the spikelets on slender, divaricate pedicels, mature seeds large. This was secured but once, among the broken rocks in the bottom of a dry canyon. It must be of excellent quality, and if it would thrive under cultivation it would form a valuable addition to our forage plants. Pine Bluffs, July 6 (3615).

Eriocoma cuspidata Nutt. (INDIAN MILLET).—A valuable grass of very wide distribution in the State. Pine Bluffs, July 5 (3606).

Muhlenbergia comata Benth. (HAIRY MUHLENBERGIA).—A smooth perennial with rather scanty leaves, 1 to 2 feet high, heads spike-like, soft-hairy, the awns short and fine. Not plentiful; usually on river bottoms and most frequently among the stones on the low banks. Evanston, July 28 (3857); Grand Encampment Creek, August 13 (3994).

Muhlenbergia gracilis brevistarata Vasey.—Growing in tufted, mat-like clumps; leaves mostly radical, short; stems slender, 6 to 12 inches high; heads large for the size of the grass, awns very short. It occurs in the hills, mostly on the naked

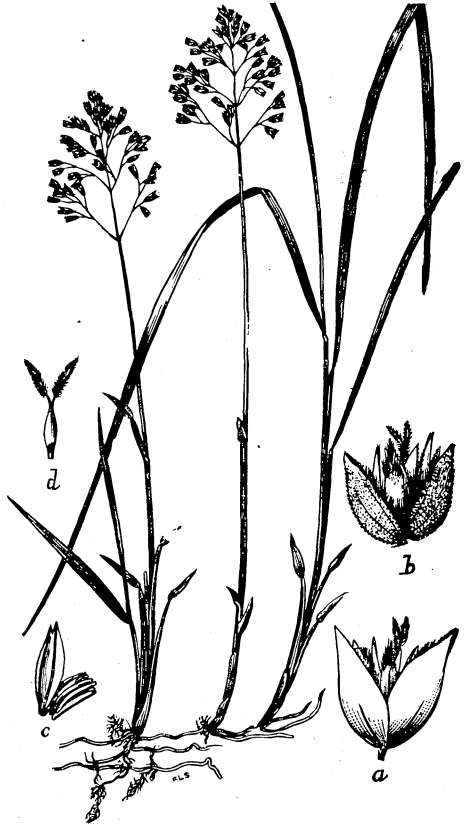


FIG. 4.—Seneca-grass (*Savastana odorata*): a, spikelet; b, florets; c, palea; d, pistil.

summits and ridges, sometimes in sufficient abundance to constitute an appreciable part of the forage. Head of Pole Creek, July 22 (3431).

Phleum alpinum L. (ALPINE TIMOTHY).—Very similar in general appearance to the ordinary field timothy, except that it is somewhat smaller. It is found on moist slopes and in the valleys at 8,000 to 11,000 feet, often constituting a large percentage of the most valuable forage. Beaver Basin, July 22 (3816); Battle Lake Mountain, August 17 (4050).

Alopecurus geniculatus fulvus Scribn. (MARSH FOXTAIL).—A succulent grass with an abundance of soft leaves, forming small, usually decumbent bunches, stems

12 to 20 inches long. It frequents wet ground, especially creek banks and shallow stream beds, where it forms tufts among the cobblestones. It is relished by stock, though it is probably rather watery in its composition. Little Laramie River, July 4 (3334); Willow Creek, July 13 (3379); Beaver Basin, July 22 (3812); Johnson's Ranch, August 9 (3908).

Alopecurus occidentalis Scribn.

(MOUNTAIN FOXTAIL, fig. 5).—A valuable grass in the mountain meadows and parks. Battle Lake, August 16 (4017).

Sporobolus airoides Torr. (FINE-TOP SALT-GRASS, fig. 6).—This grass forms large mats or sometimes considerable areas of harsh, raised sod, the short, stiff root-leaves and wiry stems giving it a disagreeable feeling to the touch; 1 to 2 feet high, producing a large, widely spreading panicle. In spite of its stiffness, on the open bottom lands stock keep it well eaten down, and it is difficult to find fruited specimens. Little Laramie River, July 24 (3452); Pine Bluffs, July 7 (3649); Granger, July 30 (3877).

Sporobolus asperifolius Thurb. (ROUGH-LEAFED SALT-GRASS, fig. 7).—Harsh but slender leaves and stems; 9 to 15 inches high, the numerous capillary pedicels of the panicle widely spreading. Probably of little value, though it may furnish some of the summer pasture on the bottom lands where it occupies the drier knolls, or more rarely is intermingled with other grasses on the lower, moist ground. Granger, July 30 (3876 and 3889).

Sporobolus confusus Vasey (fig. 8).—A small form growing in little tufts, the stems and leaves almost hairlike, and the delicate panicle widely spreading, 3 to 6 inches high. Not observed except on stony or gravelly stream banks, where it forms a scattering, inconspicuous growth. Laramie River, July 12 (3361); Grand Encampment Creek, August 13 (3990).



FIG. 5.—Mountain Foxtail (*Alopecurus occidentalis*): a, spikelet; b, floret.

Sporobolus cryptandrus A. Gray (SAND DROPSEED).—A tufted form with spreading stems, 12 to 18 inches long, occurring on sandy knolls and ridges; usually of very scattering growth, so that, though it is a nutritious pasture grass, it is of small economic importance. Hillsdale, July 7 (3660); Laramie, July 20 (3417).

Sporobolus depauperatus Scribn. (DROPSEED).—Somewhat tufted, but still forming a continuous sod, stems and leaves slender, 6 to 12 inches high. A most excellent pasture grass. Centennial Valley, July 2 (3274); Evanston, July 27 (3841); Granger, July 30 (3883); Johnson's Ranch, August 8 (3901); Grand Encampment Creek, August 13 (4002); Wagon Hound Creek, August 21 (4403).

Sporobolus simplex Scribn.—

A tiny alpine form, growing in little tufts, or sometimes as small patches of uniform sod; the fruiting heads slender and few-seeded; the fine root-leaves numerous and nearly as long as the capillary stems, which are 2 to 4 inches high. It occurs on the naked slopes in the vicinity of the permanent winter snow banks. Battle Lake Mountain, August 16 (4011).

Agrostis alba L. (REDTOP, HERD'S-GRASS).—This well-known grass occurs throughout the valleys of the whole region investigated. In many places it has no doubt been introduced, but in some of the localities where it was secured it must have been indigenous. It prefers wet ground, and thrives immensely under irrigation. In some of the valleys it is considered one of the important meadow grasses, as, for instance, at Evanston, in the Bear River Valley. Hillsdale, July 7 (3663); Evanston, July 27 (3832 and 4444); Granger, July 30 (3888); Grand Encampment Creek, August 13 (3995).

Agrostis asperifolia Trin.

(ROUGH-LEAFED BENT-GRASS).—An erect grass with long heads and numerous, ample leaves. It prefers wet ground, such as the banks of streams, partially shaded bottom lands, and more rarely boggy ground. It is a valuable constituent of the forage in such situations, and forms a part of the hay in wet meadows. Evanston, July 28 (3856); Woods Creek, August 9 (3964).

Agrostis scabra Willd. (ROUGH HAIR-GRASS).—Erect, with slender leaves and stems and narrow, or, in older specimens, widely spreading panicle, the pedicels extremely long and hair like. It forms a small part of the native grasses on most of the bottom lands; occurring as scattering specimens or small clumps, most frequent in the loamy soil of stream banks, probably of little value, but



FIG. 6.—Fine-top Salt-grass (*Sporobolus airoides*): a, spikelet; b, floret.

on open grounds grazed down with the other grasses. Head of North Vermilion Creek, July 20 (3792); Evanston, July 28 (3851); Battle Lake, August 16 (4024).

***Agrostis tenuis* Vasey (SLENDER HAIR-GRASS).**—Resembling the preceding, but smaller, the panicle and its pedicels shorter and less spreading. Collected but once, in ground then fairly dry, but probably boggy earlier in the season. Low (6 to 12 inches high), and in small quantity. Battle Lake, August 16 (4014).

***Agrostis humilis* Vasey (fig. 9).**—A bunch grass of very small proportion, only 3 to 5 inches high; seemingly very rare; only one small bunch secured on an alpine summit near a snowbank. Battle Lake Mountain, August 17 (4070).

***Calamagrostis hyperborea americana* Kearn. (SAND-GRASS; YELLOWTOP).**—A tall

fine-looking grass, with close cylindrical heads, often 3 to 4 feet high. In this range it seems to be found in abundance in wet draws and on banks where seepage water is abundant. It often forms a close, even growth, but as it requires so much water it can not be utilized, except on the wettest ground, as a meadow grass. Pine Bluffs, July 6 (3632); North Fork Vermilion Creek, July 19 (3772); Granger, July 30 (3884); Woods Landing, August 7 (3902); Medicine Bow River, August 21 (4089).

***Calamagrostis canadensis* (Mx.) Beauv. (BLUE-JOINT GRASS).**—Stems and leaves stouter than in the preceding, heads close and full, 2 to 3 feet high; infrequent, usually in wet places or on creek banks. Head of Pole Creek, July 22 (3437).

***Calamagrostis canadensis acuminata* Vasey (MOUNTAIN BLUE-JOINT).**—Much resembling the preceding in general appearance; in age the panicle is loose and spreading. It is the commoner form of this range, occurring both in open and in partially shaded ground. Its luxuriant growth and ample leaves suggests that it may be valuable under cultivation. In one mountain

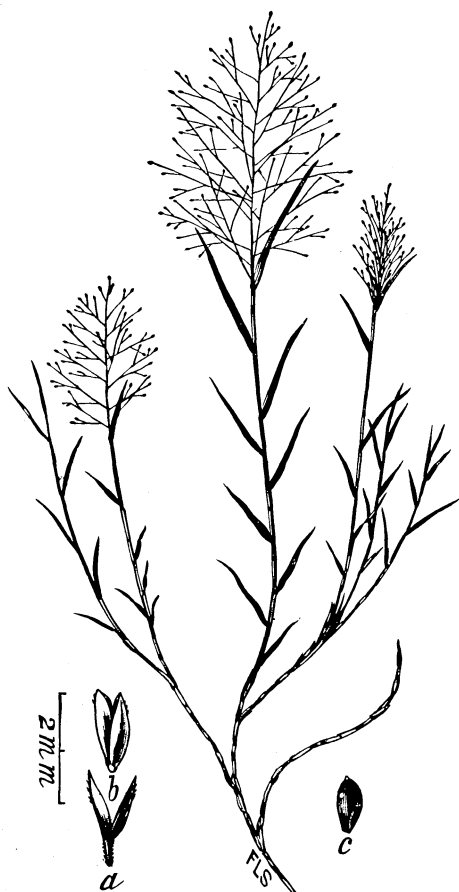


FIG. 7.—Rough-leaved Salt-grass (*Sporobolus asperifolius*):
a, empty glumes; b, floret; c, caryopsis.

locality it formed a luxuriant and continuous growth among the fallen timber. Johnsons Ranch, August 9 (3905); Woods Creek, August 10 (3946); Battle Lake, August 16 (4018).

***Calamagrostis montanensis* Scribn. (MONTANA BLUE-JOINT).**—A small erect form, with close cylindrical heads, rarely more than a foot high. It occurs on dry or even on rocky slopes, and on the drier parts of the bottom lands as scattering specimens or irregular patches of various sizes. It must be considered as a pasture grass of some value. Horse Creek, July 13 (3381); Big Creek, August 11 (3970).

Calamagrostis purpurascens R. Br. (PURPLISH REED-GRASS, fig. 10).—A mountain form, 12 to 20 inches high, with ample root-leaves and close cylindrical heads. The specimens secured formed close bunches on the rocky cliffs and on the highest summits; not abundant. Battle Lake, August 16 (4047 and 4056).

Calamagrostis scribneri Beal (SCRIBNER'S REED-GRASS).—Erect and stout, with a wealth of long broad leaves and ample heads 3 to 4 feet high; the handsomest grass of the genus, often making a dense close growth that yields an abundance of hay, presumably excellent, though the leaves are somewhat scabrous to the touch. It prefers wet ground, but thrives on the bottom lands anywhere or even on the lower slopes of the adjacent hills. Johnsons Ranch, August 9 (3920); Woods Creek, August 10 (3954); Grand Encampment Creek, August 13 (3989); Medicine Bow River, August 20 (4082).

Calamovilfa longifolia Scribn. (BIG SAND-GRASS).—A coarse grass occurring in occasional clumps, 2 to 4 feet high. Rare in this range and probably confined to the eastern part of the State, where it occurs on the dry sandy plains or hill-sides. Hillsdale, July 7 (3666).

Deschampsia caespitosa Beauv. (TUFTED HAIR-GRASS).—Densely tufted, with an abundance of long root leaves, the slender stems exceeding the leaves and terminating in large, loose, spreading panicles. It is of frequent occurrence throughout this entire range, occurring on all the streams, in the mountains on all the moist slopes, and even on alpine summits. Little Laramie River, July 4 (3337); Pine Bluffs, July 6 (3623); Beaver Basin, July 22 (3817); Evanston, July 28 (3860); Granger, July 30 (3890); Woods Landing, August 7 (3904); Battle Lake, August 16 (4008).

Trisetum subspicatum Beauv. (DOWNY OAT-GRASS).—Usually growing in small tufts, which are irregularly scattered on mountain slopes or more rarely in the valleys, root-leaves abundant, the upper stem nearly naked and bearing a short, cylindrical head, with soft, divergent awns. As a pasture grass it has value in proportion to its abundance. Battle Lake Mountain, August 17 (4045 and 4061).

Danthonia californica Boland. (CALIFORNIAN OAT-GRASS).—Decumbent at base and somewhat spreading or declined in habit, stems leafy, 20 to 30 inches high; panicle small. It is certainly very rare in the region, for which reason its forage value need not be taken into account. Observed but once as a scattering growth in an aspen grove in a moist valley. Greentop, June 29 (3253).

Danthonia intermedia Vasey (MOUNTAIN OAT-GRASS).—An erect, handsome grass with well-developed heads, 15 to 25 inches high. It occurs in small patches as an open sod in the margins of the woods or in the small parks in the mountains. In many places it is sufficiently abundant to have much value as a pasture grass. Battle Lake, August 17 (4037 and 4055); Woods Creek, August 9 (3959).

Danthonia parryi Scribn. (PARRY'S OAT-GRASS).—Somewhat similar to the preceding, but lower and with looser heads, more inclined to be tufted at base. This

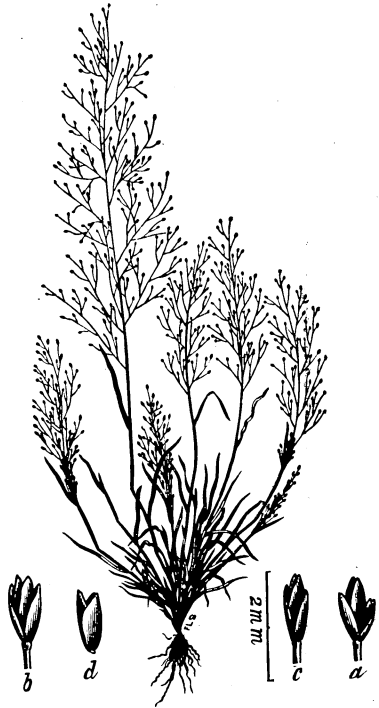


FIG. 8.—*Sporobolus confusus*: a, b, c, spikelets; d, floret.

also is of rare occurrence, and is met with only in the hills so far as observed. Secured on open hillsides, where it occurred in small patches, growing on a soil of disintegrated granite. Greentop, June 29 (3245).

***Spartina gracilis* Trin. (SLENDER CORD-GRASS, fig. 11).**—A perennial from tough underground root-stocks, rather rigid and woody, but not harsh; possibly of some value when young. It occurs as a scattering growth on sandy, alkaline soil on creek or pond banks. Laramie River, July 12 (3364); Pine Bluffs, July 6 (3630); Granger, July 30 (3885).

***Schedonnardus paniculatus* Trelease (FALSE CRAB-GRASS).**—A worthless grass of spreading habit, leaves crowded at the base, the naked scabrous stems divari-



FIG. 9.—*Agrostis humilis*: a, spikelet; b, empty glumes; c, f, florets; d, palea; e, caryopsis; g, apex of flowering glume.



FIG. 10.—Purplish Reed-grass (*Calamagrostis purpurascens*): a, empty glumes; b, floret; c, prolongation of the rachilla.

cately branched, rigid and brittle, at least when mature, 9 to 15 inches high. Of rare occurrence, usually in broken ground, such as dry ditches or plow furrows. Pine Bluffs, July 6 (3642).

***Bouteloua oligostachya* Torr. (BLACK GRAMA).**—Somewhat tufted or matted, but often a fairly uniform growth over several rods of ground in a place, the numerous leaves are largely basal, the slender stems which bear the one-sided heads, 10 to 18 inches high. This is preeminently the grass of the plains, occurring in greater or less abundance everywhere on the arid pasture lands. It is of especial

value as a pasture grass, but furnishes a part of the hay on the drier second bottom meadows. It has the reputation of being very nutritious, and the condition of the stock pastured upon it bears out this idea fully. Laramie Plains, July 19 (3409); Pine Bluffs, July 6 (3619); Hillsdale, July 7 (3658); Woods Landing, August 7 (3909).

Beckmannia erucaeformis Host. (SLOUGH-GRASS, fig. 12).—A grass of the bogs and of the margins of ponds and irrigation canals; erect, well leafed, heads long and slender, seeds flat and large, falling early and leaving the rachis bare almost as soon as it is mature. Probably of no special value, but in very wet ground it often constitutes a perceptible part of the plants that are cut for hay. Much of it, however, can not be utilized, as it grows in places where it is not accessible until so late in the season that it has lost its value for any purpose. North Fork Vermilion Creek, July 19 (3763); Evanston, July 27 (3834); Granger, July 30 (3881).

Bulbilis dactyloides Raf.

(BUFFALO GRASS).—Low

and matted, ordinarily only a few inches high; staminate and pistillate heads on separate culms. Not nearly so common as is generally supposed, for much of what passes for this is generally one of the species of Grama grass. They are, however, readily enough distinguished, especially when they are headed out. On the open range these are all grazed down so closely that it becomes difficult to recognize them. This grass occurs on the open plains, but especially in flat draws among the ridges of hills that intersect the plains at intervals. It has no significance except as a pasture grass, and there seems to be some foundation for the belief that it is gradually disappearing from the range. Pine Bluffs, July 6 (3616).

Eatonia obtusata Gray (EARLY BUNCH-GRASS).—Soft, handsome, and well leafed, 18 inches to 3 feet high, with slender, close paniced heads. In moist ground, either open or partly shaded, it makes a most luxuriant growth. Certainly a good pasture grass, and in some meadows it is a valuable part of the hay crop. Granger, July 30 (3886); Grand Encampment Creek, August 13 (3993).

Koeleria cristata Pers. (PRAIRIE JUNE-GRASS).—Somewhat tufted, very leafy at the base; stems strict and erect, bearing a close cylindrical head, very variable in size,

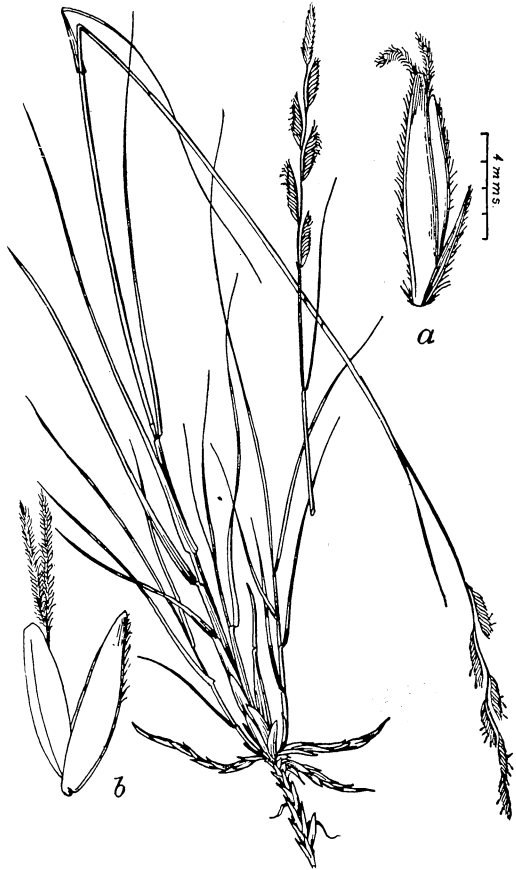


FIG. 11.—Slender Cord-grass (*Spartina gracilis*): a, spikelet; b, floret.

from a few inches to a foot or two in height. Perhaps the most generally distributed of our valuable pasture grasses, as it occurs in greater or less abundance on both plains and foothills, as well as to some extent in the mountains. It is quite variable, also, in appearance, depending no doubt largely upon the stage of development that it has reached and to some extent upon its habitat. Pine Bluffs, July 6 (3620); Beaver Basin, July 22 (3808); Evanston, July 28 (3850); Woods Landing, August 7 (3915); Battle Lake, August 16 (4040); Wagon Hound Creek, August 21 (4100).

Melica bulbosa Geyer (BULBOUS MELIC-GRASS, fig. 13).—A tall, handsome, grass, bearing small bulbs at the base of the straight stems; heads slender, but the spikelets plump; 2 to 3 feet high. An excellent grass, but usually of very scattering growth; often protected from stock by growing among the undershrubs on the banks of ravines. Not very widely distributed, in fact, observed only a few

times in the foothills. Green Top, June 29 (3265); Sheep Mountain, July 3 (3306); Battle Lake, August 16 (4023).

Distichlis spicata Greene (SALT-GRASS).—Leaves and stems somewhat slender, but rather stiff, from a few inches to a foot or more high. It is distinctively a grass of the alkaline flats, growing fairly well where salts are present in the soil to such an extent that other grasses can not live at all. It likes moisture, but is not absent from comparatively dry ground. The sod it forms is often close, but always harsh and disagreeable. In the desert regions it is valuable for the pasture it furnishes about the springs that serve as watering places for the stock on the open range. Pine Bluffs, July 6 (3631).

Poa arctica R. Brown (ARCTIC SPEAR-GRASS).—A densely-tufted grass, with erect stems and very lax heads, the slender pedicels loosely spreading. It seems to be a valuable pasture grass, but occurs mostly at high elevations, so as not to come within the ordinary



FIG. 12.—Slough-grass (*Beckmannia erucaeformis*): a, b, spike; c, spikelet; d, floret.

range of stock; it prefers moist, rich slopes or creek bottoms, and attains in such places a height of 15 to 25 inches. Head of Pole Creek, July 22 (3432).

Poa arida Vasey (BENCH-LAND SPEAR-GRASS, fig. 14).—Forming small bunches, the root leaves short but abundant, the stems slender and almost naked above, 10 to 18 inches high. Valuable as an early pasture grass on the drier bench lands, but of little value in the meadows, for it is past its prime before the other grasses are ready to be harvested. Pine Bluffs, July 6 (3643); Granger, July 30 (3887).

Poa buckleyana Nash (BUNCH-GRASS).—A bunch-grass with erect, slender stems, 15 to 25 inches high; root leaves abundant but short. One of the most widely distributed and valuable of the pasture grasses, but greatly variable in size and

appearance in different situations. Its time of development and maturity varies with the character and moisture of the soil and the altitude, so that in different localities it will be found in excellent condition throughout the season. Green Top, June 29 (3244); North Fork Vermilion Creek, July 20 (3780); Head of Vermilion Creek, July 20 (3798); Battle Lake, August 17 (4043).

Poa epilys Scribn.—Very slender stems, 12 to 18 inches high, with short, rather broad heads; root leaves small and stem nearly naked. It was met with only once at an almost alpine height, growing as scattering specimens among the broken, granite rocks. Battle Lake Mountain, August 17 (4067).



FIG. 13.—Bulbous Melic-grass (*Melica bulbosa*): a, spikelet; b, flowering glume; c, floret; d, caryopsis; e, terminal rudimentary floret.



FIG. 14.—Bench-land Spear-grass (*Poa arida*): a, spikelet; b, flowering glume; c, floret.

Poa fendleriana Vasey (FENDLER'S SPEAR-GRASS).—A small bunch-grass, 10 to 15 inches high, with numerous leaves and ample panicles. It occurs on rocky slopes in the foothills in the western part of the State; seemingly neither frequent nor abundant, but undoubtedly an excellent pasture grass. Evanston, May 29 (2970, 2986, and 2998).

Poa flava L. (FALSE REDTOP).—Tall and slender, 2 to 3 feet high, with long, spreading panicles. In some localities a conspicuous grass in the wet draws on bottom lands at least, so in inclosures where it is allowed to head out. In open ground and in pastures, stock graze it down closely, indicating that it is among

the most relished of pasture grasses; of considerable importance in localities near Evanston and Medicine Bow River. Evanston, July 27 (3848 and 3858); Medicine Bow River, August 21 (4093).

Poa glauca Vahl. (SPEAR GRASS).—This smooth, handsome bunch-grass occurs sparingly in the mountains. It prefers moist places, where, under favorable conditions, it will attain a height of 12 to 18 inches. It is an excellent pasture grass, as evidenced by the extent to which it is sought out by stock. Head of Pole Creek, June 19 (3196).



FIG. 15.—Nevada Blue-grass (*Poa nevadensis*): a, empty glumes; b, florets.

ing the slopes and summits, often in considerable abundance. Sheep Mountain, July 3 (3292).

Poa lucida Vasey (SHINING BUNCH-GRASS).—A widely distributed grass, but never greatly abundant; erect in habit, with long ample leaves; of excellent quality, and adapting itself to various habitats. Green Top, June 29 (3257; Laramie River, July 20 (3415); Woods Landing, August 7 (3906).

Poa nemoralis L. (WOOD MEADOW-GRASS).—Growing in bunches, leaves and stems slender, the panicle ample, loose and spreading; an excellent grass, attaining a height of 2 feet or more. It occurs in partly wooded areas, on the slopes or on the creek banks, where it is often a very important part of the forage. Head of Vermilion Creek, July 20 (3794); Grand Encampment Creek, August 13 (3983).

Poa laevigata Scribn. (SMOOTH BUNCH-GRASS).—A bunch-grass of much value, 1 to 2 feet high. It has adapted itself to very diverse conditions, as shown by its being found in all kinds of soil—on the strongly alkaline of the Bitter Creek flats to that of the open mountain parks; on moist creek banks and dry hillsides and ridges. It develops early, hence is of much value as early summer pasture. North Vermilion Creek, July 19 (3766); Colorado-Wyoming line, July 22 (3807); Evanston, July 27 (3837); Granger, July 30 (3891).

Poa leptocoma Trin.—A rare grass of scattering growth, the stems weak and the leaves soft and broad; observed but once as scattering, individual specimens on the broken banks of a streamlet in a subalpine park. Battle Lake, August 16 (4019).

Poa longepedunculata Scribn. (LONG-STALKED BUNCH GRASS).—A remarkably fine bunch-grass, the tufts large and close, 20 to 30 inches high; leaves short and largely basal, the numerous naked stems slender and erect; panicle ample but close. It is a grass of the hill regions, occupy-

Poa nemoralis L. var ?.—Much smaller than the preceding, with perfectly erect stems; the heads a shorter, closer panicle. Probably a form of higher altitudes. Head of Pole Creek, July 22, (3435).

Poa nevadensis Vasey (NEVADA BLUE-GRASS, fig. 15).—Forming small bunches, the ample leaves, numerous stems, and well-developed heads make this a grass that always attracts attention. In the open range it is always browsed down except where protected by fallen timber or otherwise. It seems to prefer open woods on the slopes of the foothills or, more rarely, the partly shaded stream banks. Laramie Hills, June 16 (3179); "G." Summer ranch, July 23 (3823); Granger, July 30, (3891a).

Poa pratensis L. (KENTUCKY BLUE-GRASS, fig. 16).—This well-known grass needs no description. It is widely distributed and everywhere recognized as a most important grass. Centennial Valley, July 2 (3278); North Vermilion Creek, July 18 (3758); head of North Vermilion Creek, July 20 (3796); Evanston, July 27 (3844); Woods Creek, August 9 (3942); Grand Encampment, August 13 (3999).

Poa reflexa Vasey & Scribn. (MOUNTAIN BLUE-GRASS).—A beautiful form of the higher mountains, usually as a bunch grass but often more scattering; stems moderately slender, 10 to 18 inches high; panicle loose and ample, the pedicels reflexed in age. It occurs in ravines and sometimes in abundance on the slopes in subalpine stations. That it is an excellent pasture grass hardly admits of doubt, but it is too often in most inaccessible places. Battle Lake Mountain, August 17 (4038 and 4044).

Poa sheldoni Vasey (SHELDON'S BLUE-GRASS, Pl. IV).—Stems slender and erect with well-formed heads; leaves mostly basal, short, slender, and somewhat rigid; usually occurring

as a bunch grass, varying in height from 1 to 2 feet, according to location. It probably belongs to the arid region, but is not confined to the drier situations. In fact, it occurs more frequently on the drier portions of the bottom lands and on the higher ground about spring bogs. In all such situations it must be considered as one of the valuable grasses. Its earliness detracts from its value as a meadow grass unless it can be grown by itself, as it is out of condition before the other constituents of the meadow are in condition for harvesting. Pine Bluffs, July 7 (3644); Beaver Basin, July 22 (3806); North Fork, Vermilion Creek, July 18 (3754 and 3785); Evanston, July 28 (3869).



FIG. 16.—Kentucky Blue-grass (*Poa pratensis*): a, spikelet; b, floret.

Poa wheeleri Vasey (WYOMING BLUE-GRASS, fig. 17).—Slender stemmed; 10 to 24 inches high; basal leaves numerous; panicles close or looser in age. This bunch grass is valuable as pasture, but, like the preceding, would be more so if it oftener descended into the lower altitudes of the foot hills or the plains. Centennial Valley, July 2 (3290); Battle Lake, August 17 (4049).

Grapphorum muticum Scribn. (?).—A handsome grass, with broad green leaves; rather large stems, 2 to 3 feet high; head a close, nearly cylindrical panicle, 3 to 6 inches long. Probably very rare; secured but once. Battle Lake, August 16 (4012 and 4013).



FIG. 17.—Wyoming Blue grass (*Poa wheeleri*): a, empty glumes; b, c, florets.

Panicularia americana MacM. (REED MEADOW-GRASS; TALL MANNA-GRASS).—Stems stout, 2 to 4 feet high; leaves large and abundant; the panicle ample, loose, and spreading, 6 to 12 inches long. This very handsome grass thrives on wet bottom lands and in the shallow sloughs that border our streams. Its forage value is much underestimated, for not only can immense crops of it be produced, but the quality of the hay is far above the average ordinarily secured from wet lands. Evans-ton, July 24 (3871); Woods Land-ing, August 7 (3907).

Panicularia borealis Nash (NORTH-ERN MEADOW-GRASS).—Stem weak, moderately leafy, 2 to several feet in length, sometimes rooting at the nodes in the mud at the bottoms of the ponds in which it grows; panicle very long and open, soon naked through the early disintegration of its spikelets. Of no economic importance, for it occurs, so far as my observation goes, only as scattering speci-mens in deep, clear, fresh-water ponds. Johnson's ranch, August 8 (3936); Grand Encampment, August 13 (3986).

Panicularia nervata Kuntze (NERVED MANNA-GRASS, fig. 18).—Soft, succulent leaves and stems, rather weak, 2 to 3 feet high; usually as a scattering growth in partly shaded bottom lands, but sometimes in considerable abundance in wet open meadows. It is greedily eaten by stock, but as a hay grass it probably lacks weight and substance. North Vermilion Creek, July 19 (3769); Woods Creek, August 9 (3955); Cooper Hill, August 22 (4405).

Panicularia nervata stricta Scribn.—Similar to the preceding, but smaller. Of small economic importance, as it occurs only as scattering specimens in the broken soil of the creek banks. Colorado-Wyoming line, July 22 (3818); Grand Encampment Creek, August 13 (3979).

Puccinellia airoides Wats. & Coult. (ALKALI MEADOW-GRASS).—Erect, with slender, tufted stems, 1 to 2 feet high, the panicle long, open, and spreading; a grass of the wet, saline flats and the ditch banks. Laramie River, July 4 (3332); Hillsdale, July 7 (3664).

Festuca brevifolia R. Brown (SHORT-LEAFED FESCUE).—Closely tufted, with numerous short basal leaves; stems strict, 6 to 10 inches high, the panicle close and slender; infrequent, occurring on the dry ridges of disintegrated granite. Head of Pole Creek, July 22 (3430).

Festuca elatior pratensis Scribn. (MEADOW FESCUE).—Slender, weak stemmed, 2 to 3 feet high; a few scattering specimens secured on Crow Creek. Cheyenne, July 8 (3664a).

Festuca thurberi Vasey (THURBER'S FESCUE).—A handsome Poa-like plant, forming large compact sods on the edge of the thickets along the mountain streams; leaves and stems slender, 2 to 3 feet high; inclined to be harsh to the touch, so that when mature probably not very well relished by stock. Willow Creek, July 13 (3377).

Festuca kingii Scribn. (KING'S FESCUE, fig. 19).—Thick-stemmed, 1 to 2 feet high; leaves few, short, and broad; the bases of the stems sheathed by the old leaves. This is a grass of the sandy or gravelly slopes and banks in the foothills, probably never forming a continuous sod, but sometimes abundant enough to be of importance as a pasture grass. Evanston, May 29 (2995); Sheep Mountain, July 3 (3300); "G." Summer ranch, July 23 (3826).

Festuca ovina L. (SHEEP'S FESCUE).—Densely tufted, the slender leaves and stems very numerous, 6 to 18 inches high; panicle slender, the spikelets being closely appressed; awns short but noticeable; widely distributed and often abundant, especially on dry ridges and disintegrated granite slopes. Head of Pole Creek, June 19 (3195); Green Top, June 29 (3242); Sheep Mountain, July 3 (3303); Battle Lake Mountain, August 17 (4062).

Festuca rubra L. (RED FESCUE).—Somewhat resembling the preceding, but in smaller tufts or as single specimens, stems seemingly longer and more slender. Not plentiful in this range. Colorado-Wyoming line, July 22 (3819).

Bromus breviaristatus Buckl. (SHORT-AWNED BROME-GRASS).—A fine appearing grass, 2 to 4 feet high; stems erect, leaves large and numerous, the panicle long with closely appressed or at least ascending branches. It occurs in open woods in the mountains where it sometimes forms meadow-like tracts of considerable extent. It seems to be relished by all kinds of stock, and it was noted that on Pine Mountain, where it is very abundant, sheep, being grazed there in July,



FIG. 18.—Nerved Manna-grass (*Panicularia nervata*): a, b, spikelets; c, d, florets.

were feeding upon it very freely. In high mountain meadows it would prove very valuable as a hay grass. Horse Creek, July 10 (3358). Little Laramie River, July 4 (3333); Medicine Bow River, August 20 (4073).

Bromus ciliatus scariosus Scribn.—A small form only 12 to 18 inches high; leaves slender and stems weak; panicle short and spreading, the spikelets on slender pedicels. Rare, secured but once, in a dry, stony canyon on the side of a mountain where scattering specimens occurred at intervals.

Sheep Mountain, July 3 (3305).

Bromus kalmii Gray (KALM'S CHES).—Leaves abundant, stems erect, 2 to 3 feet high; panicles many-flowered, often drooping, the pedicels slender and flexuous. This bunch grass is a very important one in some of the mountain ranges. In open woods on stony hillsides it occurs in great abundance, as it frequently does in some of the higher-lying meadows. Woods Creek, August 9 (3948); Medicine Bow River, August 22 (4083).

Bromus multiflorus Scribn. (LARGE MOUNTAIN BROME-GRASS).—Erect, moderately strong stemmed, 3 to 4 feet high, leaves large and numerous; panicles ample, close, many flowered, the spikelets erect or nearly so, awns short but evident. For further notes upon this grass, which undoubtedly has great economic value (see page 29). "G." Summer ranch, July 23 (3827); Battle Lake, August 16 (4021 and 4035); Pine Mountain, head of Vermilion Creek, July 18 (3759).

Bromus porteri (Coul.) Nash (PORTER'S CHES).—Erect, with ample leaves, 2 to 3 feet high; panicle long, its

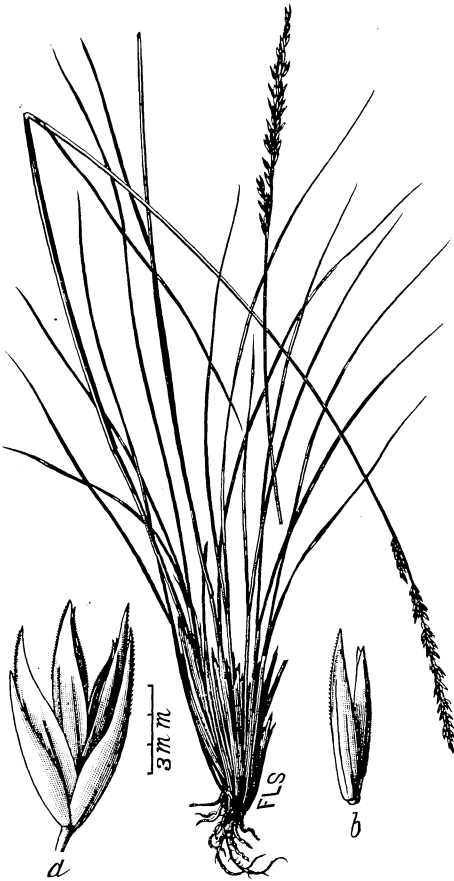


FIG. 19.—King's Fescue (*Festuca kingii*): a, spikelet; b, floret.

branches lax and spikelets on slender flexuous pedicels. Undoubtedly a valuable grass, but usually only scattering, individual specimens in the aspen copses or on the more open hillsides. Battle Lake, August 16 (4022); Cooper Hill, August 22 (4407).

Bromus scabratus Scribn. (SCABROUS CHES).—Harshly scabrous, leaves and stems slender, somewhat flexuous, 2 to 3 feet long; panicle open, spikelets very slender, on filiform flexuous pedicels. My field notes say "A very common grass on the creek bottoms at this station. It forms a portion of the general growth over all the district observed. Apparently not browsed down so fully as some of the other grasses even where stock has full access to it." Head of Vermilion Creek, July 20 (3800).

Agropyron caninoides Beal. (BEARDED WHEAT-GRASS).—This wheat-grass occurs mostly as a bunch grass; the bunches small with stoutish, erect stems; heads long, close, and well awned. It probably is rare, though it was found in fair quantity on the borders of a mountain brook and extending well up on the adjacent hillsides. Woods Creek, August 9 (3940).

Agropyron caninum R. & S. (BEARDED WHEAT GRASS).—Somewhat resembling the preceding but smaller, with shorter leaves. Probably of the plains rather than the mountains. Laramie River, July 31 (3458).

Agropyron dasystachyum subvillosum S. & S.—It is especially valuable upon saline lands and responds with an increased yield to more favorable situations. Pine Bluffs, July 5 (3604); Colorado-Wyoming line, July 22 (3804); Evanston, July 27 (3836).

Agropyron divergens Nees. (BUNCH WHEAT-GRASS).—A bunch grass, the stems and leaves densely tufted, 18 to 30 inches high; heads long, narrowly spike-like, with long, divergent, twisted awns. Common in the foothills on dry, stony ridges and slopes. Readily eaten by stock, especially before the awns have developed and after they have fallen off. Laramie Hills, June 16 (3181); Green Top, June 29 (3243); Sheep Mountain, July 3 (3298).

Agropyron pseudorepens S. & S. (FALSE COUCH-GRASS, fig. 20).—Forming dense bunches, the numerous stems stout, erect as a whole, but somewhat bent at base, spikes 4 to 6 inches long, awns short. Pronounced a most excellent grass for hay purposes, both

on account of its quality and its heavy yield. It would seem that some of the other wheat-grasses that form a uniform sod could be used to better advantage than this bunch-grass on grounds which are to be seeded to permanent meadow. Pine Bluffs, July 6 (3634); Woods Creek, August 9 (3965); Battle Lake, August 17 (4064).

Agropyron richardsoni Schrad. (RICHARDSON'S WHEAT-GRASS).—In a general way resembling the preceding, but growing mostly as scattering, individual specimens; the spikes conspicuously awned. It occurs mostly on the edges of clearings or in open woods. Hardly abundant enough to have much significance in this range. Woods Landing, August 7 (3923); Grand Encampment, August 13 (3978); Cooper Hill, August 22 (4408).



FIG. 20.—False Couch-grass (*Agropyron pseudorepens*): a, empty glumes; b, florets.

Agropyron riparium S. & S. (BANK WHEAT-GRASS).—Stems slender, erect, 2 to 3 feet high; leaves sparse, mostly basal; spike narrow, spikelets rather distant, giving an interrupted appearance. Occurring both on the saline soil of the plains and the alluvial soil of mountain parks. In the latter situations it often forms meadow-like tracts, indicating that under cultivation it may prove a valuable member of this important genus of grasses. Little Laramie River, July 24 (3447); Colorado-Wyoming line, July 22 (3813).

Agropyron spicatum S. & S. (WESTERN WHEAT-GRASS).—An erect, rather coarse species with large heads of conspicuous spikelets. It grows as a continuous but

open sod and yields a large amount of valuable forage. Pine Bluffs, July 6 (3610); Evanston, July 27 (3847); Granger, July 30 (3878); Grand Encampment, August 13 (3997).

Agropyron spicatum molle S. & S. —Very similar to the preceding but smaller; confined in this range almost wholly to saline regions, where it is of much importance. Sheep Mountain, July 3 (3299).

Agropyron tenerum Vasey (SLENDER WHEAT-GRASS).—Leaves numerous, stems slender and erect; spikes 3 to 6 inches long, the few flowered spikelets closely appressed, awns very short. As previously stated, this seems to be the most valuable of the wheat-grasses for this range. Pine Bluffs, July 6 (3628); North Vermilion Creek, July 19 (3773); Evanston, July 27 (3846); Granger, July 30 (3880); Grand Encampment, August 13 (3976); Medicine Bow River, August 20 (4076).

Agropyron tenerum ciliatum S. & S.—Smaller, more slender, spikelets less crowded. A valuable grass, but not

widely distributed. North Vermilion Creek, July 18 (3755).

Agropyron vaseyi S. & S. (VASEY'S WHEAT-GRASS).—In habit and general appearance much resembling *A. divergens*. Like that, it occupies dry slopes and the summits of hills, this especially in the "red formations" of the desert. Pine Mountain, head of Vermilion Creek, July 20 (3797).

Agropyron violaceum Vasey (MOUNTAIN WHEAT-GRASS).—Stems, stout, short, 10 to 18 inches high, spikes slender, purplish. A grass of much value and wide distribution, in this range rather rare and confined to the hill country. Laramie Hills, July 17 (3403).



FIG. 21.—*Elymus simplex*: a, empty glumes; b, florets.

- Triticum aestivum** L. (WHEAT).—Some specimens found in an old stock yard. Grand Encampment Creek, August 13 (3984).
- Hordeum jubatum** L. (SQUIRREL-TAIL GRASS).—More or less abundant throughout this entire range.
- Hordeum occidentae** Scribn.—Slender stemmed, 12 to 18 inches high; leaves abundant; spikes slender, with awns of moderate length. It forms a uniform growth but rather open sod, in which it differs from the preceding, which is usually found in tufts or bunches. This would have forage value of no mean degree except for the awns, which are said to make it objectionable. North Vermilion Creek, July 20 (3781).
- Hordeum nodosum** L. (MEADOW BARLEY).—Wagon Hound Creek, August 21 (4099).
- Elymus ambiguus** V. & S.—Slender, rather rigid leaves and stems, 12 to 18 inches high; spike narrow, 3 to 6 inches long, inclined to have an interrupted appearance; awns very short. Neither common nor abundant, collected but once, on the alkali flats bordering the banks of Hams Fork. Grauger, September 1 (4451).
- Elymus canadensis** L. (WILD RYE).—Tall and somewhat coarse, 3 to 5 feet; stems leafy; spikes dense, 4 to 8 inches long, bearded. This well-known bunch grass is confined to the drier regions of the eastern part of the State, where it is of frequent occurrence and often abundant. Pine Bluffs, July 6 (3637).
- Elymus condensatus** Presl. (GIANT RYE-GRASS).—A tall, smooth, coarse grass forming immense clumps. The most conspicuous grass throughout the entire southwestern part of the State. North Vermilion Creek, July 23 (3829).
- Elymus glaucus** Buckl.—This rye grass seems to belong to the wooded areas, occurring as scattering specimens or in small bunches in aspen thickets or among the fallen timber on wooded slopes. Battle Lake, August 16 (4016); Medicine Bow River, August 21 (4085); Cooper Hill, August 21 (4413).
- Elymus macounii** Vasey.—A bunch grass of much promise; my field notes make special mention of its abundance of soft, excellent leaves. It rarely occurs as an open, continuous sod on bottom lands or in the draws among the hills. Pine Bluffs, July 6 (3624); North Vermilion Creek, July 20 (3783).
- Elymus occidentalis** Scribn. (WESTERN RYE-GRASS).—Tall and slender stemmed, 3 to 4 feet; spikes short, pubescent, awns of moderate length. Probably rare, only one small patch of it observed; on the dry terraces separating the first and second bottom lands. Laramie River, September 15 (4470).
- Elymus simplex** Scribn. (fig. 21).—A stiff, harsh perennial, 1 to 2 feet high; spikes slender, inclined to appear interrupted, 3 to 5 inches long. But little of it observed, and that growing in small bunches on the grassy banks of an irrigating canal. Little Laramie River, July 4 (3335).
- Sitanion elymoides** Raf. (LONG-BEARDED WILD RYE).—This bunch grass differs much in appearance and size in different habitats. On the dry saline plains of the desert it forms low, compact bunches and the spikes have awns of moderate length; on moist mountain slopes the bunches are loose, the stems long and spreading, the spikes loose, and the divaricate awns of inordinate length. In any case it can not be looked upon with any favor as a forage plant. Pine Bluffs, July 6 (3608); North Vermilion Creek, July 20 (3784); Woods Creek, August 9 (3952).

SEDGES.

- Eleocharis palustris** (L.) R. & S. (COMMON SPIKE-RUSH).—Slender stemmed and of very close compact growth, 10 to 15 inches high. This species occurs in very many boggy places as a pure growth and in over-irrigated meadows it often constitutes a large percentage of the crop that is put up and labelled hay. Some forage value it no doubt has, but it is to be regretted that the better true grasses should be drowned out only to be replaced by this. Centennial Valley, July 4 (3329); Pine Bluffs, July 7 (3656); North Vermilion Creek, July 19 (3764); Evans-ton, July 27 (3833).

- Eleocharis** sp. (?).—Erect and close growing, the stems slender, 5 to 8 inches high; spike short, oblong. Common on the marshy banks of the streams and ponds. Pine Bluffs, May 15 (2899).
- Scirpus campestris** Britt. (PRAIRIE RUSH).—Stems triangular, stout and very leafy, 1 to 2 feet high; leaves broadly linear, flat, nearly equalling the stems; perennial from tubers borne at the end of short horizontal rootstocks, the annual stems arising from the previous year's tubers. The species seems able to endure any amount of alkali, as it was found in dry alkali-lake beds where no other vegetation seemed able to exist. Granger, July 30 (3874); Laramie, August 30 (4462).
- Scirpus americanus** Pers. (AMERICAN RUSH).—Long, rather slender triangular stems; spikelets small, clustered capitate, overtopped by the single involucre leaf. A common rush in most of the bogs of the region, but especially so in the saline bogs and marshes adjacent to Bitter Creek, in the desert. Pine Bluffs, July 7 (3650); Laramie, August 30 (4468).
- Scirpus lacustris** L. (GREAT BULRUSH).—Stems stout, cylindrical, smooth, and erect, spikelets umbellately clustered. Rarely wholly absent from fresh-water bogs throughout this range. Pine Bluffs, July 7 (3651); North Vermilion Creek, July 17 (3767).
- Scirpus microcarpus** Presl. (SMALL-FRUITED BULRUSH).—Erect, 3 to 4 feet high; leaves abundant and large; spikelets very numerous in an open inflorescence which approaches a compound umbel. This species prefers fresh-water ponds or the banks of slow flowing streams. It occurs in some abundance in many of the wetter meadows, where it constitutes a perceptible part of the hay product. Woods Landing, August 7, (3911); Grand Encampment, August 13 (4078).
- Carex acuta tenuior** Bailey.—A species of sedge with very slender leaves and stems, 9 to 15 inches high, growing in almost unbreakable clumps on the margins of lakes and ponds. Infrequent; Battle Lake, August 16 (4039).
- Carex athrostachya** Olney.—A slender stemmed sedge producing an abundance of excellent leaves, a valuable ingredient in many wet meadows. Centennial Valley, July 2 (3280); Wood's Landing, Big Laramie River, August 7 (3898); Grand Encampment, August 13 (4000); Medicine Bow River, August 21 (4092).
- Carex atrata** L. (BLACK SEDGE).—Another sedge with long, slender stems and numerous broad root-leaves about half the length of the stem. It forms only a scattering growth among the rocky ledges in subalpine regions. Battle Lake Mountain, August 17 (4065).
- Carex aurea** Nutt. (GOLDEN-FRUITED SEDGE).—A small form, from a few to several inches in height, flexuous stems and flat, light-green leaves, occurring about springs and in wet meadows, but rarely in sufficient amount to have any economic significance. Evanston, July 28 (3854).
- Carex deflexa media** Bailey (NORTHERN SEDGE).—This forms close mats, sometimes of great size; the leaves are especially numerous, and though it rarely exceeds 6 inches in height it has the appearance of being one of the best pasture grasses of the higher slopes and ridges in our mountains. Battle Lake Mountain, August 17 (4046).
- Carex douglasii** Boott (DOUGLAS'S SEDGE).—A low caespitose form that develops early, usually only a few inches high, but at maturity as much as a foot high in some localities. The heads are large and the leaves of excellent quality. It is an important part of the pasture in some of the localities investigated. Evanston, May 29 (3017); Laramie River, June 18 (3188); Centennial Valley, July 3 (3288); Wagon Hound Creek, August 21 (4402).
- Carex festiva stricta** Bailey.—This fine looking sedge prefers wet places, especially pond and creek banks. It produces an abundance of excellent leaves and is no doubt readily eaten by stock. As an admixture in wet meadows it would be of value. Green Top, June 29 (3255); Head of Vermilion Creek, July 20 (3701); Evanston, July 28 (3862).

- Carex festiva viridis** Bailey.—Somewhat resembling the preceeding, but larger and more leafy; bright green; seemingly it is a form belonging to the higher mountains. Battle Lake, August 16 (4012).
- Carex filifolia** Nutt. (THREAD-LEAFED SEDGE).—A densely tufted form with very slender stems and leaves, somewhat stiff, and only a few inches high; not common, occurring on dry ridges and plains in the eastern part of the State, where it undoubtedly forms a part of the early summer range pasture. Pine Bluffs, May 15 (2895).
- Carex geyeri** Boott (GEYER'S SEDGE).—A very leafy form, 6 to 9 inches high, rare and scattering, only a few specimens found among the broken, granite rock at subalpine heights. Battle Lake Mountain, August 17 (4063).
- Carex hoodii** Boott (HOOD'S SEDGE).—Stems long and slender; an abundance of fine leaves. It has the appearance of being a good forage plant, but it is not abundant. As it is a bunch sedge and belongs to high mountain regions it is doubtful whether any use can be made of it under cultivation. Battle Lake, August 16 (4033).
- Carex jonesii** Bailey (JONES'S SEDGE).—A sedge of the mountain swamps, scattering in growth, 2 feet or more in height. Battle Lake, August 16 (4015).
- Carex lanuginosa** Michx. (WOOLLY SEDGE).—This slender-stemmed sedge, with its wealth of long, fine leaves, seems to the writer to be the most desirable of the sedges for hay purposes. While it abounds in swamps, yet it will grow where the soil is simply wet. It forms a very dense growth, and it seems that in meadows too wet for the better grasses or where natural flooding occurs that this may be worthy of introduction. Pine Bluffs, July 7 (3653); north fork Vermilion Creek, July 19 (3768); Evanston, July 27 (3831); Granger, July 30 (3882); Grand Encampment, August 13 (3988).
- Carex marcida** Boott. (CLUSTERED FIELD-SEDE).—Perennial from horizontal root-stocks, from which arise numerous stems, 12 to 20 inches high, from the lower part of which spring numerous narrow leaves somewhat shorter than the stems. This is one of the most valuable sedges that was found in the native meadows. It thrives in wet ground, but will also do well on comparatively dry ground. It usually is found as an admixture with other forage plants, but in a few instances it was found as a pure growth on the drier ground of the bottom lands. It is considered valuable as a hay crop, and the writer knows that it is closely grazed down where stock have access to it. North Vermilion Creek, July 19 (3770); Granger, July 30 (3873); Grand Encampment Creek, August 13 (4001).
- Carex marcida alterna** Bailey.—This form is very similar to the preceding in its habit of growth. In one locality it was found very abundant on both the drier and wetter ground of the meadows. Wagon Hound Creek, August 21 (4401).
- Carex multinoda** Bailey (MANY-JOINTED SEDGE).—A particularly handsome sedge, the numerous flat, green leaves and the slender stems, surmounted by comparatively large heads, give it the appearance of a valuable plant. It is, however, a bog form and hence difficult to utilize. Centennial Valley, July 2 (3275); "G," Summer ranch, July 23 (3822); Grand Encampment Creek, August 13 (3996).
- Carex nebraskensis** Dewey (NEBRASKA SEDGE).—This swamp sedge is very variable in size, but often attains a height of 2 feet or more. The leaves are very abundant, relatively broad and often nearly as long as the stems, on which are borne two to four large cylindrical heads. Though the hay produced from it will not weigh very heavy in proportion to the bulk, yet it must be considered as a valuable product. In meadows that are flooded early in the season it constitutes a considerable part of the whole hay crop. Pine Bluffs, July 7 (3654); Evanston, July 27 (3830); Cooper Hill, August 22 (4409).
- Carex nebraskensis praevia** Bailey.—Green Top, June 29 (3256); Medicine Bow River, August 21 (4094).
- Carex nigrescens** C. A. Meyer.—Springing from underground root-stocks, producing an abundance of short root leaves, few naked stems, 6 to 9 inches high; in wet

- places in the alpine regions of the mountains. Battle Lake Mountain, August 17 (4042).
- Carex nova** Bailey (THE NEW SEDGE).—Erect and slender, stemmed with short flat leaves; 15 to 25 inches high; somewhat scattering, in the wet spruce woods and along the creeks in the mountains. Probably of value as pasture. Battle Lake, August 16 (4007).
- Carex preslii** Steud. (PRESL'S SEDGE).—A tufted alpine form with numerous soft, slender leaves that are greatly relished by grazing animals; 8 to 10 inches high. Battle Lake Mountain, August 17 (4053).
- Carex pyrenaica** Wahl.—A very small, tufted form, only a few inches high, strictly alpine, observed only about the permanent snowdrifts on the mountains. Battle Lake Mountain, August 17 (4058).
- Carex raynoldsii** Dewey (RAYNOLDS' SEDGE).—Erect but weak stemmed, leaves broad and flat; the short cylindrical heads usually two, a foot or more high; rare and very scattering. Battle Lake, August 16 (4020).
- Carex scirpoidea** Michx. (RUSH-LIKE SEDGE).—Erect with an abundance of short root leaves, only 6 to 10 inches high. It develops early on wet ground on bottom lands and so furnishes a perceptible part of the spring pasture. Pine Bluffs, May 15 (2901); Laramie, May 31 (2943).
- Carex siccata** Dewey (HILLSIDE SEDGE).—From strong, tufted root-stocks, slender stems and numerous leaves as long as the stems. This is a dry-ground sedge, being abundant on fertile hillsides, where it develops early and gives much valuable pasture. Evanston, May 29 (3001); also frequently collected in the Laramie Hills.
- Carex stenophylla** Wahl. (DWARF SEDGE).—This is the earliest on the Laramie plains, but in many places it also maintains itself till late in the season. It often forms a fairly uniform growth, but its small size (4 to 6 inches in height) and slenderness make it seem rather insignificant. As spring pasture on the plains, it has value. Colorado-Wyoming line, Sweetwater County, July 23 (3803); Grand Encampment Creek, August 13 (3991).
- Carex tenella** Schk. (SOFT-LEAFED SEDGE).—A very delicate, slender-stemmed and soft-leaved plant, a foot or less high, usually in damp, shaded places; never observed in sufficient abundance to have any economic significance. Woods Creek, August 9 (3941).
- Carex tolmiei** Boott.—A stout, mountain form with long, broad leaves, a foot or so high, usually as strongly root-tufted bunches. Not abundant enough to have much significance but evidently relished by grazing animals. Battle Lake, August 16 (4005 and 4072).
- Carex trichocarpa aristata** Bailey (AWNED SEDGE).—One of the largest of the sedges, stems thick and producing a succession of heads, the leaves broad, flat, and often overtopping the stems, the whole producing a very dense growth 3 to 4 feet high. It prefers very wet ground, but produces abundantly on ground that dries out in late summer. I have seen considerable areas yielding an immense amount of forage harvested with the usual machinery. Laramie, September 15 (4469).
- Carex trichocarpa imberbis** Gray (?).—This is much smaller than the preceding with longer, denser heads; somewhat tufted and usually growing in the margins of creeks or ponds; not plentiful. North Vermilion Creek, July 20 (3802).
- Carex utriculata minor** Boott. (SMALL BOTTLE SEDGE).—A rank-growing sedge of the wettest ground, with thick stems and long, broad leaves, often 2 or 3 feet in height; heads usually three to four on each culm. It is very abundant and widely distributed; on grounds that become sufficiently dry to admit of it, it is cut and is said to form fair hay. Head of North Vermilion Creek, July 20 (3801); Evanston, July 28 (3861); Johnson's Ranch, Big Laramie, August 8 (3896); Battle Lake, August 16 (4036).

- Carex vallicola** Dewey.—Soft-leaved and slender stemmed, less than a foot high; on the hillsides, not abundant. Evanston, May 29 (3000).
- Carex variabilis** Bailey (?).—A slender, erect form usually found in the margins of streams, 12 to 20 inches. Pine Bluffs, May 15 (2900).
- Carex variabilis elatior** Bailey.—A bunch sedge of the most pronounced sort, so tufted that it can scarcely be broken up, leaves abundant and stems fruiting freely, 20 to 30 inches high. Probably of small economic value. Woods Creek, August 9 (3937); Grand Encampment, August 13 (3985).
- Carex eleocharis** Bailey (?).—Filiform stems and leaves from tuberous root-stocks, only 5 to 8 inches high. It makes a very close growth and has the aspect of an *Eleocharis*. In the locality where it was secured it was exceedingly abundant in the drier parts of the meadows, even to forming continuous sods. Big Creek, August 11 (3972).
- Carex** sp.—A small, leafy species, 6 to 8 inches high, somewhat tufted and forming a considerable growth on saline ground bordering some lakes. Little Laramie River, July 24 (3445).

OTHER FORAGE PLANTS.

Besides the grass-like plants given in the preceding list there are many in the region designated the summer range, that furnish much browsing during the summer months, but these need not be mentioned in detail here. It is sufficient to call attention to the following as among the more important:

First in importance are *Leguminosæ*, which throughout the entire range are abundantly represented. Species of *Astragalus* abound everywhere and many of them are freely eaten. In view of the fact that some (*Astragalus mollissimus*, etc.) have reputed poisonous properties, it is a question yet to be solved how generally they may be accepted as forage plants. Species of *Thermopsis*, abundant in some localities, are not without suspicion of having injurious properties. Among the legumes that pass unchallenged may be named the clovers (*Trifolium longipes* Nutt., and other species) and *Hedysarum* (*H. americanum* Britt. and *H. mackenzii* Rich.), all of which are of frequent occurrence and in some localities abundant. These are greatly relished by stock and furnish an important part of the pasture.

In the eastern part of the State another genus that is particularly well represented is *Psoralea*, the following species being abundant: *P. lanceolata* Pursh, *P. linearifolia* T. & G., and *P. tenuiflora* Pursh. Of the value of these species the writer can not speak for he does not even know that stock feed upon them.

Attention may be called to the following list, the plants of which are abundant in the summer range as well as in the desert. (For more or less complete notes upon their economic value see the Red Desert list (p. 24) in which they have been individually considered.)

<i>Astragalus.</i>	<i>Chenopodium.</i>
<i>Lupinus.</i>	<i>Sarcobatus.</i>
<i>Vicia.</i>	<i>Sueda.</i>
<i>Atriplex.</i>	<i>Eriogonum.</i>
<i>Eurotia lanata.</i>	<i>Artemisia.</i>

FLORA OF THE RED DESERT.

The Red Desert is a fairly distinct area, an area with a flora peculiar to and characteristic of an arid, saline region. Its plants are therefore listed separately, and all vascular forms that were secured are included, whether they are forage plants or not. This is done to indicate as fully as possible the real character of the vegetation and thus, by inference, the economic possibilities of the region.

The following list of plants is based upon specimens secured during the summer of 1897 along the line of the Union Pacific Railroad, from Pine Bluffs, on the eastern border, to Evanston, on the western border of the Desert. There are represented, besides the districts contiguous to the road, localities both north and south, some of which are from 40 to 70 miles distant from it. As the following are but the collections of one season, they must fall far short of constituting the complete flora of the region.

CONIFERÆ.

Juniperus knightii A. Nels. (DESERT JUNIPER).—Usually a shrub-like tree, much branched from the base, but occasionally more arboreous. Common in the sandstone bluffs along Bitter Creek and its tributaries. (See p. 7.) Point of Rocks, June 1 (3096); Rock Springs, July 26.

SCHEUCHZERIACEÆ.

Triglochin maritima L. (SEASIDE ARROW-GRASS).—A low, tender, herbaceous plant, 6 to 10 inches high, abundant on wet alkali flats; possibly eaten by stock to some extent. South Butte, July 13 (3748).

GRAMINEÆ.

Stipa comata Trin. & Rupr. (NEEDLE-GRASS).—A loosely spreading bunch grass, easily known by the long, twisted awns that the fruits bear. A grass of some forage value and readily eaten by stock in the autumn and winter after the long, vicious beards have fallen. Bitter Creek, July 12 (3700).

Stipa lettermani Vasey (LETTERMAN'S NEEDLE-GRASS).—A slender form with short awns, growing as a bunch grass among the sage-brush on the dry summits of the hills. Probably in itself valuable, but only occurs in small quantity. South Butte, July 13 (3738).

Stipa nelsoni Scribn. (NELSON'S NEEDLE-GRASS).—A tall grass, with very long heads and awns of medium length, forming small and rather loose bunches, with a fair amount of leaves; usually found in open-timbered areas, but also among the sagebrush on the slopes below the permanent winter snowbanks; not plentiful. Fifteen-Mile Springs, July 13 (3731).

Eriocoma cuspidata Nutt. (INDIAN MILLET, see fig. 2).—A widely distributed bunch grass, from a few inches to a foot or more in height, easily known by its peculiarly branched panicles and the large, softly silky seeds. It is a grass of much value. Point of Rocks, June 1 (3094); Red Desert, June 3 (3122); Wamsutter, July 10 (3680); Creston, August 28 (4416).

Sporobolus airoides Torr. (FINE-TOP SALT-GRASS, see fig. 6).—This grass forms patches of various sizes on the hummocks and drier ridges of bottom lands. The sod seems stiff and the stems, while somewhat slender, are also rather rigid. It forms, however, in some localities much valuable pasture. Black Rock Springs, July 13 (3723); Green River, September 1 (4457).

Sporobolus depauperatus Scribn. (DROPSEED).—A small but valuable grass, forming a close, even sod of numerous slender leaves and stems; valuable as pasture, but of rare occurrence in the desert. South Butte, July 13 (3745); Creston, August 29 (4425).

Calamagrostis hyperborea americana Kearn. (SAND-GRASS; YELLOW TOP).—A tall, slender grass, usually forming an even growth, on wet ground in either open or shaded places. Rare in the desert, occurring only about spring bogs. Black Rock Springs, July 13 (3717).

Calamagrostis neglecta Gaertn. (PONY-GRASS).—An erect grass usually found in the margins of ponds and ditches, forming an even growth and bearing an abundance of slender leaves; a fine appearing and valuable grass. South Butte, July 13 (3750).

Deschampsia caespitosa Beauv. (TUFTED HAIR-GRASS).—A bunch grass with slender stems and numerous leaves, common throughout the State, sometimes in comparatively dry ground, but usually along streams and about spring bogs. It furnishes much pasture, but after it matures and dries on the ground it does not seem to be relished by stock. Black Rock Springs, July 13 (3718); Fifteen-mile Springs, July 14 (3727).

Koeleria cristata Pers. (PRAIRIE JUNE-GRASS).—A straight, slender grass with cylindrical heads, forming small tufts, 8 to 12 inches high. Common on the plains and in the hills, and forming an important part of the early pasture; far from common in the Red Desert. Creston, August 28 (4417).

Catabrosa aquatica Beauv. (WATER WHORL-GRASS, fig. 22).—A soft, watery grass, usually with stems partly prostrate and rooting in the soft mud of the sluggish streams and spring-fed bogs, where it abounds. Horses and cattle eat it readily and will wade knee-deep in the mud to secure it. South Butte, July 13 (3734).

Distichlis spicata Greene. (SALT-GRASS; ALKALI-GRASS).—A stiff, pale, harsh grass, occurring on alkali flats, even where the ground is white with salt. Though far from the best, it is eaten down by stock where other forage is scarce. Black Rock Springs, July 13 (3722).

Poa buckleyana Nash. (BUNCH-GRASS).—A slender-stemmed, narrow-leaved bunch-grass of much value in this State, but of small significance in the Desert proper. On some of the moister slopes and draws it becomes of some importance. Green River, June 1 (3067); Bitter Creek, June 2 (3100); Creston, August 28 (4418).

Poa juncifolia Scribn. (ALKALI BLUE-GRASS, Pl. V).—A small, erect bunch-grass with slender, pointed leaves. This new species belongs to the arid region, but it is not confined to the desert exclusively. Usually of scattering growth, it sometimes forms almost a continuous sod. Reported as one of the desirable



FIG. 22.—Water Whorl-grass (*Catabrosa aquatica*): a, b, spikelets; c, d, florets.

pasture grasses, and would probably be of value as a meadow grass, especially where the soil and the irrigation waters are not of the best. Black Rock Butte, July 13 (3721).

Poa laevigata Scribn. (SMOOTH BUNCH-GRASS).—This species is found throughout the southern part of the State, in the desert as well as in the hills and mountains, sometimes in comparatively dry places, but preferring moist banks and wet flats. It forms a valuable part of the early summer forage. Red Desert, June 3 (3118); Pole Creek, June 19 (3197); Wamsutter, July 10 (3668); Bitter Creek, July 12 (3708); Point of Rocks, July 14 (3751).

Poa lucida Vasey (SHINING BUNCH-GRASS).—A grass of more than usual importance. It grows to a height of 1 or 2 feet, producing numerous stems and broad leaves of excellent quality. It constitutes an appreciable part of the forage in the desert as well as in the summer range. It is found on the dry plains, but is more abundant and luxuriant in the vicinity of spring bogs and creeks. Point of Rocks, June 1 (3093); Bitter Creek, July 12 (3707); South Butte, July 13 (3733).

Poa sheldoni Vasey (SHELDON'S BLUE-GRASS).—Bitter Creek, July 12 (3696).

Puccinellia airoides Wats. & Coult. (ALKALI MEADOW-GRASS).—This slender, erect grass is seldom seen except in the margins of ponds and ditches, and seems to prefer water with a considerable percentage of alkali. Whether it could be introduced to advantage on wet alkali ground the writer is unable to say, but that stock will readily eat it when fresh is well known. Bitter Creek July 12 (3687); Black Rock Springs, July 14 (3715); South Butte, July 14 (3737).

Agropyron dasystachyum subvillosum S. & S. (NORTHERN WHEAT-GRASS).—An erect grass with slender heads and numerous slender, somewhat spreading root-leaves. On the dry plains it is of small size (6 to 10 inches high), but on bottom lands or under irrigation it makes a luxuriant growth. It cures readily on the ground and forms a valuable part of the winter pasture and must also be reckoned among the valuable meadow grasses. Wamsutter, July 9 (3679); Fifteen-Mile Springs, July 14 (3730).

Agropyron spicatum S. & S. (WESTERN WHEAT-GRASS).—A somewhat coarse and harsh wheat-grass but nevertheless of much value; not abundant in the desert but in some of the draws in sufficient amount to possess forage value. Wamsutter, July 10 (3672); Black Rock Butte, July 14 (3724).

Agropyron spicatum molle S. & S.—This seemed to be the commonest of the wheat grasses in some parts of the desert, as, for instance, in the clay gumbo on the banks of Bitter Creek. It impresses one as a grass that would be of value in meadows where soil and irrigation water are both of poor quality. Wamsutter, July 10 (3674); Bitter Creek, July 12 (3706); Point of Rocks, July 12 (3713).

Agropyron tenerum Vasey (SLENDER WHEAT-GRASS).—A slender-stemmed grass with very slender heads and rather sparsely leaved, from 15 to 30 inches high. Probably the most important wheat-grass in southern Wyoming. Bitter Creek, July 12 (3709); South Butte, July 13 (3736).

Agropyron tenerum ciliatum S. & S.—In general appearance and in value much like the preceding but of rarer occurrence; hence among the native forage of little importance, though under cultivation and irrigation it has proved a most desirable form. Wamsutter, July 11 (3677).

Agropyron vaseyi S. & S. (VASEY'S WHEAT-GRASS).—This forms dense bunches of some inches or even a foot in height. It will hardly be thought of as a wheat-grass on account of the numerous spreading awns, but it is a valuable grass on account of the early forage it furnishes on otherwise barren slopes and shaly hilltops. Stock eat it readily, especially while it is young. Bitter Creek, July 12 (3695).

Hordeum jubatum L. (SQUIRREL-TAIL GRASS).—This, so commonly called fox-tail in this region, is too well known to need any description. It is the most undesirable grass of the West. Though considered an annual, it will probably be

found to be longer lived in some places at least; common in the desert in many wet alkaline places, especially along the railroad. Wamsutter, July 10 (3670).

Hordeum nodosum L. (MEADOW BARLEY).—A slender bunch grass, or sometimes a rather continuous and uniform growth, forming small meadow-like tracts on saline flats and basins. It is a light grass, and the short-bearded heads soon break up when mature, but if cut early and cured would probably make fair hay. Bitter Creek, July 12 (3692); South Butte July 13 (3746).

Elymus condensatus Presl. (GIANT RYE-GRASS).—A tall, coarse grass growing in dense bunches. It is common in the deeper draws and on the slopes below the permanent wintersnowdrifts. Wamsutter, July 10 (3675); Fifteen-mile Springs, July 14 (3728).

Elymus salinus Jones (DESERT RYE-GRASS, fig. 23).—Varying from a small, erect form of scattering growth to a coarse, harsh plant a foot or more in height, forming close tufts. It seems to be peculiar to dry, poor soil, usually occupying the driest ridges and benches of the second bottom or the sand dunes of the foothills. Only rarely does it form a uniform, continuous growth. It seems that it might prove a valuable grass for certain kinds of soil, both for pasture and hay. A very moderate amount of water for irrigation would probably suffice to secure fair results. Green River, May 31 (3059); Bitter Creek, July 12 (3694); Point of Rocks, August 30 (4436).

Sitanion elymoides Raf. (LONG-BEARDED WILD-RYE).—A small bunch grass with wide-spreading awns. It can hardly be pronounced other than worthless. It has not only formidable beards, but it matures early, becomes brittle, and soon goes to pieces and is blown away. Green River, May 31 (3058); Wamsutter, July 10 (3669).



FIG. 23.—Desert Rye-grass (*Elymus salinus*): a, empty glumes; b, florets.

CYPERACEÆ.

Eleocharis palustris R. & S. (COMMON SPIKE-RUSH).—Slender stems 10 to 18 inches high; spikes narrowly oblong. An exceedingly common form in the saline bogs of the desert; especially abundant on the low banks of Bitter Creek, where it was freely browsed by the horses on the emigrant trail. Bitter Creek, July 12 (3689).

Eleocharis sp.—Much smaller than the preceding, with short, oblong spikes, making a dense growth on the black, mucky bogs about springs in the desert. Readily eaten by our horses while we were in camp. Black Rock Springs, July 13 (3719).

Scirpus americanus Pers. (AMERICAN BULRUSH).—Perennial from slender root-

stocks; stems triangular, erect, moderately stout; leaves long and abundant. Remarkably abundant on the banks of Bitter Creek and in some of the spring bogs. Fifteen Mile Springs, July 14 (3726); Point of Rocks, July 12 (3714); South Butte, July 14 (3740).

Scirpus campestris Britt. (PRAIRIE BULRUSH).—An exceedingly leafy species developed from tubers, which are annually produced at the end of short, horizontal root-stocks. Bitter Creek, September 3 (4459).

Carex marcida debilis Bailey.—This is a small sedge with numerous weak stems from a thick, horizontal root-stock, only 6 to 9 inches high; on the drier ridges about the spring bogs; not abundant. Black Rock Springs, July 13 (3720).

Carex multinoda Bailey.—This slender-stemmed sedge produces a large amount of long, tender leaves, and forms a close sod. It is one of the most valuable from a forage standpoint of the sedges of the desert. South Butte, July 13 (3735).

Carex nebraskensis Dewey (NEBRASKA SEDGE).—Very leafy, the leaves broad, almost as long as the stems, 1 to 2 feet or more in height. Usually in very wet ground, such as ditches and meadow bogs. When these dry out in late summer it is cut to a considerable extent for hay. It of course occurs in the desert only rarely, but in some of the bogs it is quite abundant. South Butte, July 13 (3741).

Carex stenophylla Wahl.—A small, scattering form only a few inches high, usually developing early; among the sagebrush in the desert it is too scattering to have any significance. Creston, August 28 (4415).

Carex teretiuscula Good.—This form has very slender, almost cylindrical leaves and stems but makes a very close and even growth on wet saline soil, often in patches of considerable size. Black Rock Springs, July 13 (3716 and 3725); South Butte, July 13 (3734a).

JUNCACEÆ.

Juncus balticus Willd. (BALTIC RUSH).—A well-known rush with rather rigid stems which arise quite regularly from a creeping, underground root-stock. It varies greatly in both size and habitat. In wet ground, as in the margins of a stream, it may attain a height of 3 feet or more; on dry sandy slopes, where it was sometimes found to occur in the desert, it may be scarcely a foot high. It probably has little forage value, though it is eaten to some extent with the other vegetation when intermingled with it. Point of Rocks, June 1 (3095); Bitter Creek, July 12 (3690).

Juncus confusus Coville.—A slender form of compact growth, 10 to 15 inches high. In some of the deeper draws in the desert where the spring snows lie late this forms extensive patches of close sod. Whether it is eaten to any extent by stock of any kind the writer is unable to say. Creston, August 29 (4427).

Juncus xiphioides montanus Engelm.—Tall and slender with ample flat leaves, 20 to 30 inches high. It is abundant in many of the spring bogs, and seems to be freely browsed by stock. South Butte, July 13 (3739).

LILIACEÆ.

Allium mutabile Michx. (WILD ONION).—Peculiar among the wild onions in that it sometimes produces little bulbs in the inflorescence. All of the specimens collected bore bulblets. Not common. In a draw among the hills north of Rock Springs. The Gap, July 25 (3600).

Allium reticulatum Don. (FRASER'S WILD ONION).—A common form on the slopes of the hills throughout the desert. Green River, May 31 (3033); Point of Rocks, June 1 (3076).

SALICACEÆ.

Salix cordata mackenzieana Hook.—This willow becomes a small, rather shapely tree. It seems to be a very common form on the banks of Green River and some of its tributary creeks. Green River, May 31 (3066).

Salix fluviatilis Nutt. (RIVER-BANK WILLOW).—This little slender-stemmed and slender-leaved form so common on all creek and river banks seems to be equally common on the banks of Bitter Creek and its tributaries. It forms a green fringe or even large patches on the low, salt-encrusted banks. Not usually thought to have any value, but here in the desert occasionally browsed by sheep, especially when snow makes other feed hard to obtain. Bitter Creek, June 2 (3102).

Salix bebbiana Sargent. (BEBB'S WILLOW).—It was something of a surprise to find this willow in the heart of the desert. In a draw near the railroad at Creston, August 27 (4270).

POLYGONACEÆ.

Eriogonum campanulatum Nutt. (NARROW-LEAFED ERIOGONUM).—Often browsed by cattle, but of no considerable value. The Gap, north of Rock Springs, July 25 (3597).

Eriogonum effusum Nutt.—A small, branched plant with a woody base, the young stems tender and eaten by sheep; not plentiful. In the clay draws at the head of Salt-Wells Creek, July 17 (3753).

Eriogonum ovalifolium Nutt.—A small caespitose plant, exceedingly common on both plains and hills. There are several forms of it, the commoner one having white flowers, but in the desert, where it is especially abundant, bright yellow forms predominate. It is probably of no economic importance. Point of Rocks, June 1 (3087); Bitter Creek, June 2 (3099); Red Desert, June 3 (3117).

Rumex tuberosum A. Nels. (TUBEROUS DOCK).—On some of the alkali-covered flats adjacent to Bitter Creek this unusual plant was found. A dock springing from large oblong tubers which lie shallowly buried in the loose, ash-like alkali soil. From these the plants spring up early, the stems, a foot or more in height, bearing long spikes of flowers; the large, bright-red wings of the fruits make them very conspicuous on the otherwise almost naked ground. Bitter Creek, June 2 (3114).

CHENOPODIACEÆ.

Chenopodium album L. (LAMB'S QUARTERS).—This well-known weed seems to be at home even in the desert, except in the more pronounced of its alkali soils. Wamsutter, July 10 (3685); Bitter Creek, July 12 (3705).

Chenopodium fremontii Wats. (FREMONT'S GOOSEFOOT).—A succulent, branched, leafy plant, 1 to 2 feet high; if growing thickly it is more slender and less leafy. This must be placed among the plants of possible forage value. It thrives on saline soil, in some localities making a pure growth, and if it can be shown that it has forage value large crops of it can readily be grown. Wamsutter, July 10 (3671).

Chenopodium glaucum L.—This is a spreading form of goosefoot with thick, fleshy leaves, and succulent stems. It thrives in soil impregnated with alkali, and, as was said of the preceding one, if it has any value, large crops of it can be grown on otherwise worthless alkali soils. Bitter Creek, July 12 (3704).

Chenopodium leptophyllum Nutt. (NARROW-LEAFED GOOSEFOOT).—A slender, willowy form, a foot or so in height. Bitter Creek, July 12 (3704a).

Blitum capitatum L. (STRAWBERRY BLITE).—This seems to be very rare, only a few specimens being seen. South Butte, July 13 (3544).

Monolepis nuttalliana Greene.—A small, much branched, succulent plant, 5 to 7 inches high, common on saline soils throughout the West. Wamsutter, July 11 (3686).

Atriplex argentea Nutt. (SILVERY SALT-SAGE).—A branched, annual plant, with silvery leaves and stems, common about alkali lakes. Possibly it has forage value during its season, but when mature it seems to become dry and worthless. Howell Lakes, September 1 (4466).

Atriplex confertifolia (Torr.) Wats. (SPINY SALT-SAGE).—A much-branched, spiny shrub, 15 to 20 inches high, producing early in the season a large amount

of thick, succulent leaves and enormous quantities of flat, winged seeds. The leaves and seeds are greatly relished by sheep. Green River, May 31 (3044); Bitter Creek, July 12 (3701); Spring Creek, August 18 (4248); Point of Rocks, August 30 (4431).

***Atriplex expansa* Wats.** (SPREADING SALT-SAGE).—A slender-branched, silvery annual, with small, triangular leaves; common on alkali flats, where it sometimes forms a continuous growth. To be of value it would have to be harvested shortly before it was mature. If left to mature on the ground it is of little value. Wamsutter, July 10 (3673).

***Atriplex hastata* Linn.** (SPREADING ORACHE).—Usually a tall, coarse, weed-like plant, often widely branched; either on saline or on salt-free ground, dark green or rarely somewhat scurfy. Probably of little value. Mud Springs, July 16 (3752).

***Atriplex nuttallii* Wats.** (NUTTALL'S SALT-SAGE).—A perennial with shrubby base and spreading branches; leaves thick and succulent, numerous; seeds abundant. This is the plant that the sheep man has particularly in mind when he speaks of salt-sage. It is the most important forage plant of the desert. Green River, May 31 (3060); Red Desert, June 3 (3121); Wamsutter July 10 (3667).

***Atriplex pabularis* A. Nels.** (NELSON'S SALT-SAGE).—An erect, slender-stemmed perennial, 8 to 16 inches high, producing a large number of succulent leaves and much fruit. As a promising fodder plant for strongly saline soil it is certainly worthy of trial. Point of Rocks, July 12 (3712); August 30 (4429); Granger, July 30 (3893).

***Atriplex truncata* Gray.**—A much-branched, silvery annual that grows luxuriantly on the saline soils of the desert in many places. It would yield a large quantity, if not very good

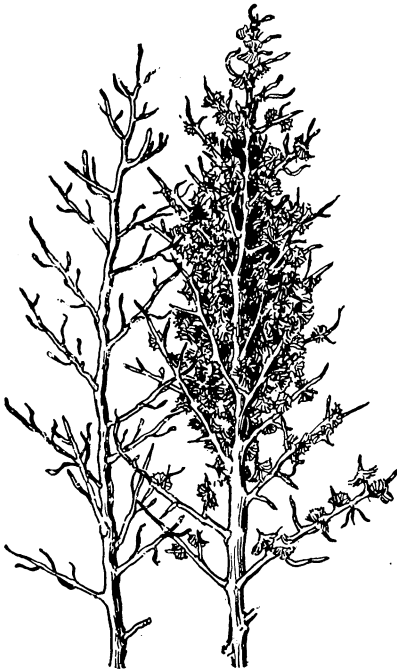


FIG. 24.—Grease-wood (*Sarcobatus vermiculatus*).

quality, of fodder if cut before maturity. Point of Rocks, August 30 (4430).

***Eurotia lanata* Moquin.** (WINTER-FAT; SWEET SAGE).—A well-known, much-branched plant, a foot or more high from a shrubby base, white, with long hairs when young, darker when old. Exceedingly common throughout the region; highly prized as sheep feed, especially in the desert. Wamsutter, July 10 (3682).

***Kochia americana* Wats.**—A small plant, much branched from the woody base, 6 to 10 inches high. The tender annual shoots are eaten by stock, and form a part of the spring forage; the younger twigs are also browsed to some extent during the winter months. Green River, May 31 (3043); South Butte, July 13 (3743); Point of Rocks, August 30 (4439).

***Sarcobatus vermiculatus* Torr.** (GREASE-WOOD, fig. 24).—An erect shrub with spiny branches, very variable in size; usually not more than 2 or 3 feet high, but sometimes 6 or 8, with wide-spreading branches. Even this contributes to the sheep feed in the desert, the slender, fleshy leaves and the numerous winged seeds being greedily eaten, as well as the more tender twigs. Wamsutter, June 4 (3130); Bitter Creek, September 3 (4456).

- Grayia spinosa** Moquin. (SPINY-SAGE).—A branched, spiny shrub, with oblong, thick, succulent leaves. It produces enormous quantities of flat, winged seeds. These, with the leaves, fall early, and are collected by the wind into little drifts or piles under the bushes and in the hollows of the ground. When sheep are fed over the ground these leaf piles are the first to disappear. Abundant on the slopes of the hills adjacent to Bitter Creek and its tributaries. Green River, May 30 (3029); Bitter Creek, July 12 (3698).
- Dondia diffusa** Heller.—A small, succulent annual, a few inches in height; common on wet alkali flats. Probably of small forage value. South Butte, July 13 (3749).
- Dondia multiflora** Heller (SHRUBBY BLITE).—A small plant with numerous succulent stems from a woody base, 6 to 12 inches high; common in alkali basins and on the banks of Bitter Creek. Its forage value unknown. Green River, May 31 (3042).
- Salsola tragus** L. (RUSSIAN THISTLE).—A much-branched, succulent spiny annual, becoming a tumbleweed when mature. It is still rare in the desert. Observed only at Rock Springs and Green River.

NYCTAGINACEÆ.

- Abronia** sp.—Probably a new species, but lacking fruits, without which it can not be sufficiently characterized for publication. On the dry bluffs. Green River, May 30 (3021).

CARYOPHYLLACEÆ.

- Silene menziesii** Hook. (MENZIES'S PINK).—A small, leafy, branching perennial, growing on wet banks, varying in height from a few inches to a foot. Observed but once in the desert. Bitter Creek, July 12 (3532).
- Arenaria congesta** Nutt. (BUNCH SANDWORT).—A small, erect plant, growing in bunches 4 to 6 inches high, with grass-like stems and leaves, and bearing a globular head of flowers. It is not known whether this is eaten by stock. Very abundant on some of the sage-brush slopes in the desert. South Butte, July 13 (3732).
- Arenaria hookeri** Nutt. (HOOKER'S SANDWORT).—A strongly matted plant, only a few inches high, with rigid, pointed leaves and white, star-like flowers. Common on dry, rocky points. Green River, June 1 (3069).
- Arenaria nuttallii** Pax. (NUTTALL'S SANDWORT).—A low plant with spreading stems and pointed leaves, occasional on the driest, shaly slopes. Green River, May 31 (3054).

RANUNCULACEÆ.

- Oxygraphis cymbalaria** Prantl. (SEASIDE CROWFOOT or BUTTERCUP).—A low, smooth buttercup, spreading by runners; common on wet or marshy saline soil everywhere. Noted in very many places in the desert.

CRUCIFERÆ.

- Stanleya pinnata** Britton.—Erect, with entire or incised leaves, 2 to 3 feet high; flowers yellow, in a long spike. Green River, May 30 (3034).
- Stanleya pinnata integrifolia** Robs.—Somewhat similar to the preceding, but with all the leaves entire. Rock Springs, July 25 (3596).
- Thelypodium** sp.—A slender, branching form, occasionally seen on the Green River bluffs; the species not yet determined. May 30 (3034a).
- Lepidium medium** Greene (WESTERN PEPPERGRASS).—A much-branched annual, 6 to 12 inches high. Flowers very numerous, inconspicuous. Abundant in some of the sandy draws of the desert. Point of Rocks, June 1 (3092).
- Lepidium montanum** Nutt. (LARGE-FLOWERED PEPPERGRASS).—Tufted perennial with numerous stems, 4 to 8 inches high; petals white and unusually large for the genus. It seems to prefer saline soil. Bitter Creek, June 2 (3106).

- Sisymbrium canescens** Nutt.—A slender, branching mustard with yellow flowers; the most abundant mustard in the desert, sometimes forming considerable fields of yellow among the sage-brush on sandy slopes, or in the draws. Point of Rocks, June 1 (3078); Wamsutter, June 4 (3126).
- Sisymbrium linifolium** Nutt.—A mustard with slender stems, simple or several from the base; leaves entire or nearly so, smooth. Very abundant in many places throughout southern Wyoming. Wamsutter, June 4 (3127).
- Physaria** sp. (?)—A small, leafy perennial of the double bladder-pod crucifers. Rather abundant on the dry shale cliffs. Green River, May 30 (3032).
- Bursa bursa-pastoris** Britton (SHEPHERD'S PURSE).—This was noted in several places along the railroad.
- Draba glacialis** Adams (WHITLOW-GRASS).—A small, tufted crucifer, scarcely more than 1 inch high. Green River, June 1 (3071).
- Arabis canescens** Nutt. (ASHY ROCK-CRESS).—A slender, sparingly branched perennial, about 1 foot high, common in some sandy draws among the sage-brush. Point of Rocks, June 1 (3077).
- Arabis brebneriana** A. Nels. (BREBNER'S ROCK-CRESS).—A form rare in the locality. Fort Steele, June 5 (3135).
- Streptanthus longirostris** Wats.—Sparingly branched, from 1 to 2 feet high; frequent on the sandy river bottom. Green River, May 31 (3040); Point of Rocks, June 1 (3082).

CAPPARIDACEÆ.

- Cleome lutea** Hook. (YELLOW CLEOME).—An erect, glabrous, somewhat branched herb, 1 to 2 feet high, flowers yellow, and the pod borne on a long, slender stipe. Abundant on the sandy bottoms. Green River, May 31 (3046).

SAXIFRAGACEÆ.

- Heuchera parvifolia** Nutt.—Perennial from a thick root, with a rosulate cluster of root-leaves and slender leafless stems, bearing short spike-like panicles of small flowers, 9 to 18 inches high. Infrequent; on the slopes below the winter snowdrifts. South Butte, July 13 (3540).
- Philadelphus occidentalis** A. Nels. (WESTERN SYRINGA).—A branched shrub, 3 to 5 feet high, peculiar to dry, desert canyons. It was an agreeable surprise to find a clump of this syringa in one of the canyons near Rock Springs, July 15 (3595).

ROSACEÆ.

- Holodiscus dumosus** Heller.—A branched shrub, 2 to 5 feet high; very rare within the borders of the desert; only below the permanent winter snowdrifts. South Butte, July 13 (3536).
- Potentilla glandulosa** Lindl. (GLANDULAR CINQUEFOIL).—A handsome perennial plant, some 18 to 30 inches high, sparingly branched; flowers yellow. Only on moist slopes below snow banks. South Butte, July 13 (3534).
- Potentilla anserina** L. (SILVER-WEED).—A tufted, spreading plant, common on wet, saline soil everywhere in the desert as well as elsewhere in the State.
- Geum macrophyllum** Willd. (LARGE-LEAFED AVENS).—A perennial herb, a foot or two in height, sometimes branched above, with large, lobed root-leaves on long petioles. Infrequent; on the moist slopes below the winter snow banks. South Butte, July 13 (3543).
- Cercocarpus parvifolius** H. & A. (MOUNTAIN MAHOGANY).—A stiff, scraggy shrub, 3 to 6 feet high; common on rocky slopes throughout the southern part of the State. Observed in several places in the desert on the winter snow slopes.

DRUPACEÆ.

***Prunus demissa* Walp. (WESTERN WILD CHERRY).**—A shrub or small tree, varying greatly in size in different situations. In the desert it occurs only below the brow of some of the steeper hills, where the winter snows become piled and remain late in the season. Observed in a few localities and collected at The Gap, south of Rock Springs, July 25 (3599).

PAPILIONACEÆ.

***Lupinus argenteus* Pursh. (SILVERY LUPINE).**—A perennial, bushy, branched plant, 1 to 2 feet high, bearing long, dense spikes of purple flowers; pods, silvery, silky, and containing only a few large seeds. In some of the grassy draws among the hills. Creston, August 29 (4428). The lupines seem to thrive in the desert, and if it could be shown that they have any economic value they could undoubtedly be cultivated.

***Lupinus leucophyllus* Dougl.**—Somewhat similar to the preceding, but occupying drier situations. The driest bluffs and ridges do not seem to be unsuited to it. It is by far the commonest lupine in the desert, and great crops of it were observed even on the summits of the white Green River bluffs. Green River, May 30 (3023); Bitter Creek, June 3 (3109); Fifteen-Mile Spring, July 13 (3729).

***Astragalus grayii* Parry (GRAY'S MILK-VETCH).**—A small, erect form, 8 to 12 inches, with yellowish-white flowers in a rather short raceme. Scattering and rare. Bitter Creek, June 3 (3115) and July 12 (3530).

***Astragalus haydenianus nevadensis* Jones.**—This form was collected and noted in several places. Of unknown forage value. Bitter Creek, June 3 and July 12 (3116 and 3711).

***Astragalus hypoglottis* L. (PURPLE MILK-VETCH).**—A low, spreading plant, only a few inches high, but often forming compact beds. It has the appearance of making excellent pasture, and looks as if it might be a good substitute for clover. Stock graze it down in some localities, and it is said that as an ingredient of hay, sheep pick this out first. It thrives on saline soil even where there is an excess of alkali, as for example on the low banks of Bitter Creek. There is no reason to think that it would be more difficult to secure a crop of this than of many other plants that are used for forage. The question that remains to be settled is, Are the plants of this genus nutritious and safe? Some of the species have reputed poisonous qualities; for example, *A. mollissimus*, one of the "locos." It is yet to be determined which are the valuable and safe species. Bitter Creek, July 12 (3688).

***Astragalus megacarpus* Gray (LARGE BLADDER-POD VETCH).**—A spreading succulent plant with large, thin, inflated pods and small seeds. This also thrives in saline soil, forming large, green mats on the alkaline flats of Bitter Creek; June 3 (3113).

***Astragalus* sp.**—An erect, slender-stemmed and slender-leaved form, found in the sandy slopes of the Bitter Creek hills. Point of Rocks, June 1 (3081).

***Vicia dissitifolia* Greene (AMERICAN VETCH).**—A slender-stemmed, vine-like plant, climbing over other plants among which it is growing; vines 2 to 3 feet in length; accounted most excellent forage. On several occasions stockmen have brought specimens saying "If you can tell us how to secure enough of this we will be satisfied; we want nothing better." It makes excellent hay; sheep especially do well upon it. It is widely distributed, but rarely forms anything like a full crop of forage. The possibilities under cultivation are yet to be determined. Bitter Creek, July 12 (3703).

***Vicia linearis* Greene (NARROW-LEAFED AMERICAN VETCH).**—Very similar to the preceding, but smaller in every way, with very narrow leaves. Equally valuable as forage, but not abundant. Bitter Creek, June 2 (3104).

LINACEÆ.

Linum lewisii Pursh. (LEWIS'S WILD FLAX).—A plant with slender leaves and wand-like stems arising from a woody, perennial root, 1 to 2 feet high; common in the State, but rare in the desert. Red Desert, June 3 (3119).

ANACARDIACEÆ.

Rhus trilobata Nutt. (STINKING SUMACH).—A small, glabrous, branching shrub; leaves, three-lobed; very common on dry ridges and canyon sides. Green River, May 31 (3065).

MALVACEÆ.

Malvastrum coccineum Gray (RED FALSE MALLOW).—A much-branched perennial herb, with silvery leaves and large, red flowers. Plant not more than a few inches high. Green River, May 31 (3057).

LOASACEÆ.

Mentzelia sp. (?).—A small form not yet determined; possibly new.

CACTACEÆ.

Echinocactus simpsoni minor Engelm.—A small, globular cactus; infrequent. South Butte, July 13 (3553).

Opuntia polyacantha Haw. (MANY-SPINED OPUNTIA).—Composed of many flat, obovate joints, fiercely spiny. Very abundant. Wamsutter, July 11 (3523).

Opuntia polyacantha platycarpa Coulter.—In general appearance very similar to the preceding. Both are here often called Prickly Pear cactus. Bitter Creek, July 12 (3528).

ONAGRACEÆ.

Epilobium sp. (?).—Two species in this genus were collected, but they do not seem to agree exactly with any of the descriptions at hand, so they are left unnamed. Nos. 3542 and 4272, from South Butte and Creston, respectively.

Taraxia breviflora Nutt.—A small, stemless plant, with a cluster of root-leaves out of which the flowers hardly rise. Creston, August 29 (4273).

Anogra albicaulis Britton (PRAIRIE EVENING PRIMROSE).—An herbaceous plant, with rather slender white stems, almost simple or branched from the base, 6 to 15 inches high; large white flowers, becoming pink as they grow older. Green River, May 31 (3064); Point of Rocks, June 1 (3075).

Chylisma scapoidea Small.—An herbaceous branching plant, with dark green leaves, and naked flowering stems, from a few inches to a foot high. Common especially on railroad embankments. Green River, May 30 (3025).

UMBELLIFERÆ.

Peucedanum macrocarpum Nutt. (LARGE-FRUITED PARSLEY).—A stemless form, with dissected leaves spreading out close to the ground, producing its flowers and large seeds early in the season; roots large and fleshy. Point of Rocks, June 1 (3086).

Cymopterus sp. (?).—A species of this genus that is as yet undetermined was secured at Point of Rocks, June 1 (3083).

GENTIANACEÆ.

Gentiana affinis Griseb. (OBLONG-LEAFED GENTIAN).—A perennial with leafy clustered stems, 6 to 12 inches high. Common on low, wet ground. Point of Rocks, August 30 (4275).

POLEMONIACEÆ.

- Phlox canescens** T. & G. (HOARY PHLOX).—A small, tufted, or matted form, blossoming early on the naked hills. Green River, May 30 (3030a).
- Phlox douglasii longifolia** Gray.—A small, rigid plant, with woody base and pungent leaves, only a few inches in height. Point of Rocks, June 1 (3084).
- Gilia congesta** Hook.—An erect, herbaceous plant, with spreading branches, 6 to 10 inches high; on sandy ground. Green River, May 31 (3045); South Butte, July 13 (3548).
- Gilia cæspitosa** A. Nels. (*Gilia pungens cæspitosa* Gray).—A much-matted form, with pungent leaves. Occurring frequently on the white chalk-like cliffs overlooking Green River. May 30 (3030).

HYDROPHYLLACEÆ.

- Emmenanthe scopulina** A. Nels.—A small, depressed annual, from the white bluffs, may be thus referred for the present at least. Bitter Creek, June 2 (3105).
- Emmenanthe salina** A. Nels.—Frequent in the abrupt, shale bluffs. Green River, May 30 (3026).

BORAGINACEÆ.

- Lappula texana** Britton (WESTERN STICKSEED).—An erect, almost simple or sometimes much branched, annual, 6 to 15 inches high. Common nearly everywhere in the State. Green River, June 1 (3068a).
- Oreocarya flava** A. Nels. (YELLOW-FLOWERED OREOCARYA).—Stems numerous and spreading from deep-set roots, 4 to 8 inches long, yellowish-hairy and bearing numerous yellow flowers. A striking plant on some of the sandy slopes and draws in the Bitter Creek hills. Point of Rocks, June 1 (3074); Bitter Creek, June 2 (3098).
- Oreocarya** sp. (?).—Two small, white flowered-forms were collected, which are yet unnamed. Green River, June 1 (3072); Red Desert, June 3 (3121).
- Oreocarya** sp. (?) near *O. affinis* Greene.—An erect form, simple or branched from the base, 3 to 6 inches high. On the driest cliffs. Green River, May 30 (3035).

SCROPHULARIACEÆ.

- Pentstemon fremontii** T. & G. (FREMONT'S BEARD-TONGUE).—One to several herbaceous stems from a short, woody rootstock, 3 to 6 inches high, root-leaves numerous, clustered, somewhat ashy colored. Bitter Creek plains, June 2 (3097).
- Pentstemon arenicolus** A. Nels. (SAND-DUNE BEARD-TONGUE).—A very handsome plant, branched from the base, stems 4 to 8 inches high, and bearing a profusion of large, blue flowers. Point of Rocks, June 1 (3090).
- Pentstemon jamesii** Benth. (JAMES'S BEARD-TONGUE).—Much branched from the base, only a few inches high, foliage pale or ashy. Green River, May 31 (3052).
- Pentstemon radicosus** A. Nels. (TUFTED BEARD-TONGUE).—An erect form, with slender stems, borne in great clusters from a compact mat of tough, slender roots, 6 to 9 inches high, leaves small and nearly uniform in size. Point of Rocks, June 1 (3089).
- Pentstemon strictus** Benth.—With long, tapering or wand-like erect stems, and a terminal spike of large, handsome flowers. South Butte, July 13 (3538).
- Castilleja** sp. (?).—A tall, slender form, much resembling *C. linearifolia* Benth.; rare, only a few specimens secured. South Butte, July 13 (3545).
- Adenostegia ramosa** Greene.—This small, much branched annual is remarkably abundant throughout the desert. Wamsutter, July 11 (3522).

PLANTAGINACEÆ.

- Plantago eriopoda** Torr. (WESTERN PLANTAIN).—This is rarely absent from wet alkali flats or creek banks.

COMPOSITÆ.

- Coleosanthus microphyllus** Kuntze.—A small plant from a woody base, from which arise numerous strict, slender branches, 5 to 10 inches high; the small leaves very numerous. Only a few specimens noted. The Gap, July 25 (3594).
- Chrysothamnus collinus** Greene (HILLSIDE RABBIT-BRUSH).—A small, much branched shrub, less than a foot high, stems and leaves yellowish-green. Eaten by sheep as a last resort. Point of Rocks, August 30 (4435).
- Chrysothamnus linifolius** Greene (CREEK-BANK RABBIT-BRUSH).—A slender, willowy shrub, 2 to 3 feet, with bright-green linear-lanceolate leaves. It was observed only on the immediate banks of the strongly saline creeks, where it was very abundant. Granger, July 30 (4137); Rock Springs, July 30 (4143); Point of Rocks, August 30 (4440).
- Chrysothamnus pumilus** Nutt. (?).—A small shrub with shreddy bark, the new branches being light-colored or almost white, stems and leaves glabrous, branched and spreading, but rarely more than 12 to 18 inches high. Wamsutter, July 11 (3524).
- Chrysothamnus speciosus** Nutt. (?).—A rather stout, branched shrub, 3 feet or more in height, the new twigs slender, green or yellowish, bearing numerous long linear leaves. Differing from the other Rabbit-brushes of the region in that it does not form close clumps, but grows as single, conspicuous shrubs, branched above, thus simulating in habit a miniature tree. Creston, August 28 (4419).
- Chrysothamnus stenophyllus** Greene.—A small shrub, the older branches spreading, the younger somewhat fascicled and erect, white. It prefers sandy slopes and ridges. Point of Rocks, August 30 (4434). The forage value of the Rabbit-brushes is very small. Sheep men say that in emergencies sheep will crop the young branches and leaves, but that they leave this forage as soon as other feed is at hand.
- Stenotus acaulis** Nutt.—A plant with numerous naked stems each bearing a large head of yellow flowers. Leaves from the woody base slender and very numerous. Common on the clay and shaly slopes; Green River, May 30 (3022).
- Petradoria pumila** Greene.—Some seemingly nearly typical plants were secured at South Butte, July 13 (3551).
- Townsendia strigosa** Nutt.—Abundant on the white bluffs about Green River, May 30 (3031).
- Aster adscendens** Lindl.—The nearly simple, wand-like stems about a foot high, usually growing in clumps. Rare in the desert, only observed on the slopes below the winter snowdrifts. South Butte, July 13 (3553).
- Machaeranthera sessiliflora** Greene.—Infrequent. Creston, August 28 (4271).
- Xylorrhiza parryi** Greene.—Very abundant on clay slopes throughout the desert. Red Desert, June 3 (3123).
- Erigeron condensatus** Greene.—A small, spreading form, abundant in the hills near Point of Rocks, June 1 (3088).
- Erigeron subtrinervis** Rydb.—Occasionally in the thickets below the winter snowdrifts on the steeper slopes. South Butte, July 13 (3539).
- Gnaphalium palustre** Nutt.—A small spreading herb, scarcely 2 inches high; usually found in old buffalo wallows or in the loose soil of ditch banks. Creston, August 29 (4274).
- Iva axillaris** Pursh.—A weed-like plant, branching freely and becoming 6 to 9 inches high. It is very abundant on the low banks of Bitter Creek. July 12 (3525).
- Balsamorhiza hirsuta** Nutt.—Very rare, only a few plants secured. South Butte, July 13 (3552).
- Hymenopappus luteus** Nutt.—A very tomentose form, much branched, 3 to 6 inches high, was secured on the bluffs at Green River, May 31 (3051).

- Tetranneuris lanata** Greene.—A perennial plant with numerous root-leaves and naked stems bearing single yellow heads, 3 to 4 inches high. Excellent specimens were secured of this good species which until recently has been suppressed by merging it into *T. acaulis* Greene. Green River, May 31 (3068).
- Tanacetum nuttallii** T. and G. (NUTTALL'S TANSY).—A small, caespitose perennial producing little spherical heads of flowers on slender, naked stems, 2 to 3 inches long. Green River, June 1 (3049).
- Artemisia cana** Pursh. (WHITE-LEAFED SAGE-BRUSH).—A small shrub, 2 to 3 feet high, with slender branches and long, entire leaves, grayish-white in color. Of the sage-brushes this is the best forage plant. Creston, August 28 (4421); Hat Creek, August 20 (4250).
- Artemisia pedatifida** Nutt.—A low, matted sage occurring frequently on the alkaline flats and in the clayey draws. Though small and inconspicuous it probably furnishes considerable forage for sheep. Bitter Creek, June 2 (3103).
- Artemisia spinescens** Eaton (BUD BRUSH; SPINY SAGE-BRUSH).—Early in the spring this forms a low, spherical clump of tender leaves and flower buds that are much relished by sheep. Green River, May 30 (3028).
- Artemisia trifida** Nutt.—A small shrub with deeply three-cleft leaves, not common; principally in the hill region. Not sufficiently abundant to have any economic significance.
- Artemisia tridentata** Nutt. (COMMON SAGE-BRUSH).—The best known shrub of the great, arid West, varying immensely in size in different situations, from a dwarf shrub less than a foot high to almost tree-like proportions; common on the plains and at increasingly higher altitudes up to the subalpine parks of the mountains.
- Artemisia** sp. (?).—A small, almost herbaceous form with slender stems and numerous, entire leaves was found growing interspersed among the grasses in a wet draw among the hills. It may possibly be a form of *A. mexicana* Willd., but more probably is new. If it could be grown as a crop it looks as if it might have forage value.
- Senecio canus** Hook.—A perennial herb of no value as forage; in the draws at Green River, June 1 (3070).
- Tetradymia canescens** DC.—A closely branched shrub, 9 to 15 inches high, leaves and branches whitish with fine hair, producing dense clusters of yellow flowers. Probably eaten to some extent by sheep, the tender twigs in the winter, the young leaves and twigs in late spring. Bitter Creek, July 12 (3699); Point of Rocks, August 30 (4432).
- Tetradymia canescens inermis** Gray.—Very similar to the preceding, but smaller and more compactly branched. Bitter Creek, June 2 (3107).
- Tetradymia nuttallii** T. & G.—An intricately branched shrub, 1 to 3 feet high, less whitened with hair than the preceding, horridly prickly with rigid, sharp, divergent spines; the young branches soft and freely nipped off by sheep. Green River, May 31 (3061); Fort Steele, June 5 (3134); Bitter Creek, July 12 (3697).
- Tetradymia spinosa** H. & A. (see Pl. III, fig. 2).—More slender and less branched than the preceding, the branches perfectly white, with tomentum or matted wool; the leaves are dropped early in the season and the compact, naked mass of white twigs form a very conspicuous part of the vegetation on the otherwise often rather naked slopes and hills. Though the older stems are rather sharp-spiny, yet this forms a valuable constituent of the winter forage for sheep and antelope.
- Carduus leiocephalus** Heller.—A small thistle with white, woolly leaves; not abundant. Bitter Creek, July 12 (3529).



FIG. 1.—THE REAL RED DESERT.

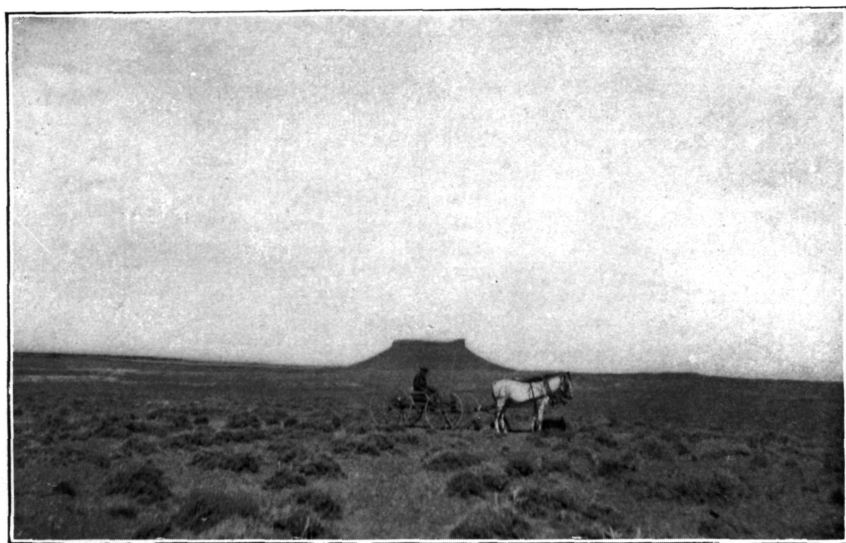


FIG. 2.—THE GREATER RED DESERT.

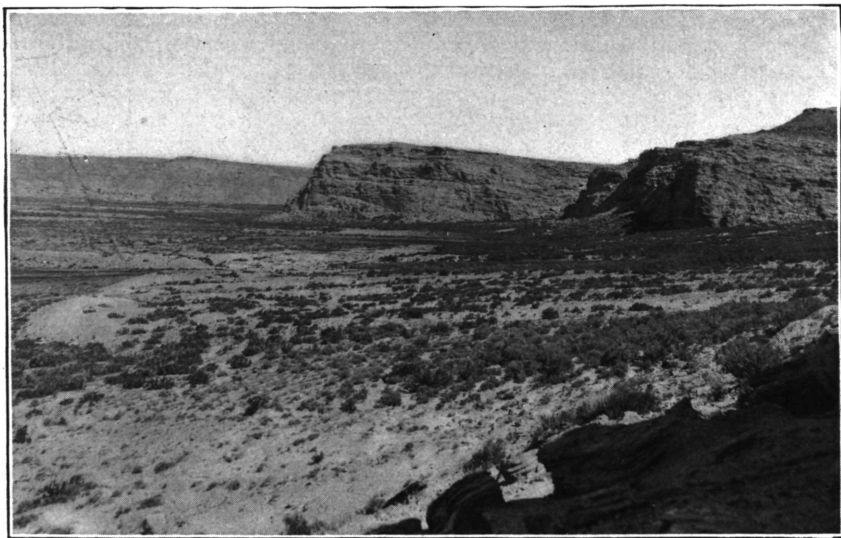


FIG. 1.—POINT OF ROCKS, BITTER CREEK VALLEY.



FIG. 2.—THE IDEAL SUMMER RANGE.

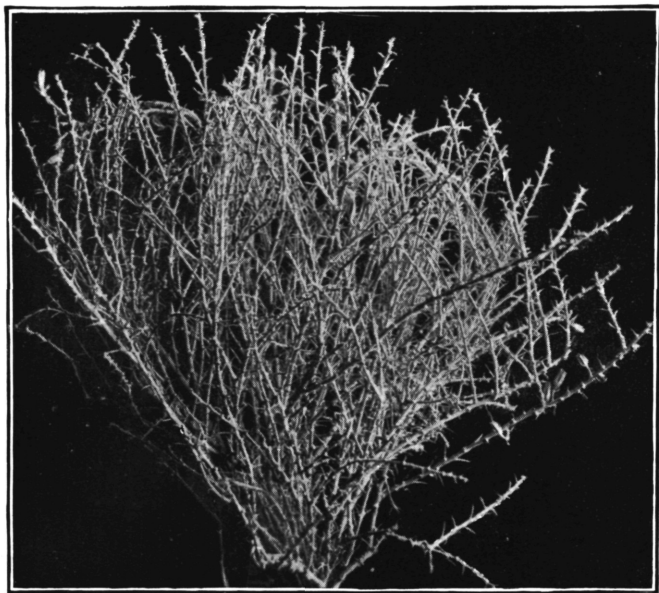


FIG. 1.—*TETRADYMIA SPINOSA* H. & A.

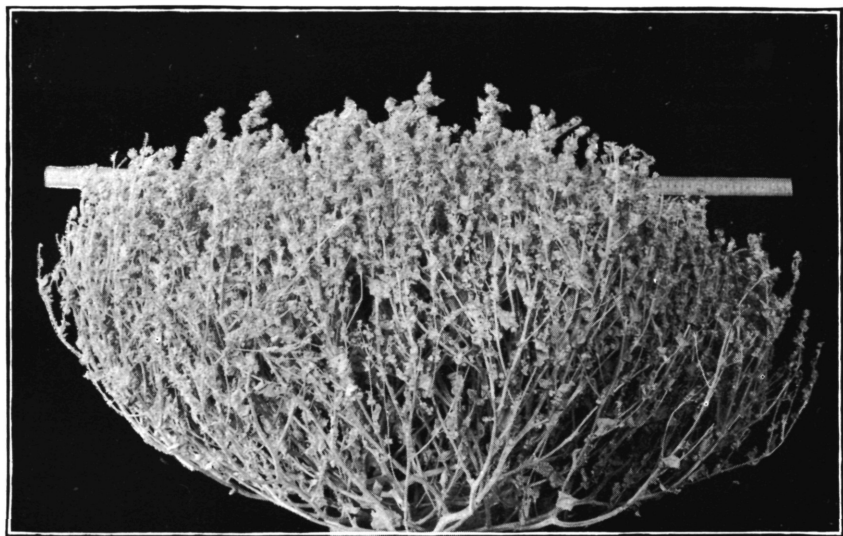
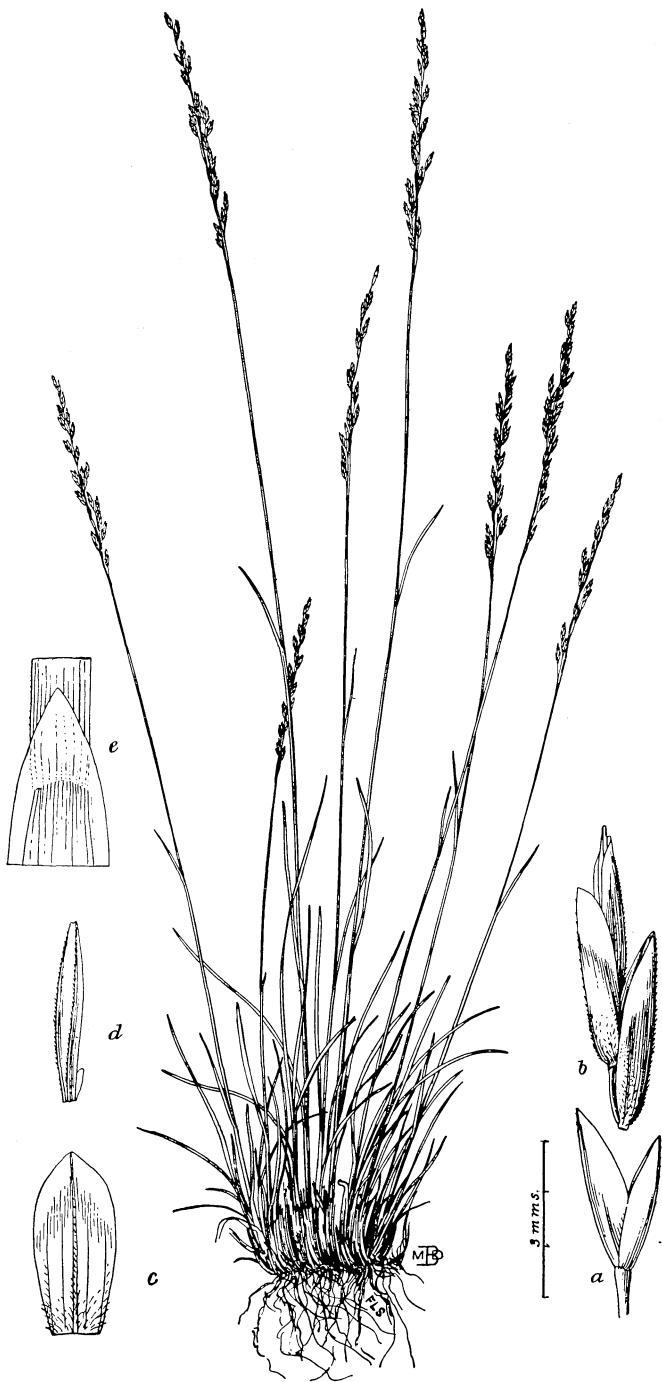


FIG. 2.—*ATRIPLEX VOLUTANS* A. Nels.



SHELDON'S BLUE-GRASS (*POA SHELTONI* Vasey).
a, Empty glumes; b, Florets; c, Ligule.



ALKALI BLUE-GRASS (*POA JUNCIFOLIA* Scribn.).
a, Empty glumes; b, Florets; c, Flowering glume; d, Palea; e, Ligule.

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